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THE

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GREAT BRITAIN'S COMMERCIAL SUPREMACY.

THE recent speeches of Lord Rosebery and Sir Henry Fowler at Wolverhampton prove how wide-spread is the interest which the question of the maintenance of our commercial supremacy is arousing at the present time. The subject is one which is being freely discussed in the great daily journals as well as in the technical press representative of the interests of every class of trade and industry; and considerable diversity of opinion is manifest, though there is an undoubted tendency towards a pessimistic view of the situation. In order to arrive at a true appreciation of the facts, it is desirable to distinguish between the avoidable and the inevitable. To the latter category we assign the fact that the great rival nations of America and Europe can point to a more rapid ratio of increase of commercial and industrial activity during the past half-century than Great Britain. It must be remembered that our insular position, combined with maritime supremacy and comparative freedom from dynastic quarrels, gave us a lead of some two centuries over our rivals, dating from the time when expansion of learning and free thought followed upon the torpor of the Middle Ages and gave wings to human liberty and activity. For over a century Great Britain practically commanded and supplied the markets of the world; and it was not until the upheaval caused by the French Revolution created a great middle class, free and zealous to acquire wealth, that the full natural resources of civilized countries began to be developed. This development was arrested in America by scarcity of population and the Civil War, and in Central Europe by the crushing effects of the Napoleonic campaigns. But so soon as the political and social conditions of these countries afforded the free scope for commercial and industrial pursuits which Great Britain had already enjoyed for a long period, it became inevitable that peoples kindred in blood and tradition to ourselves, and surrounded by the same natural advantages, should not only arrest the flow of our produce into their markets, but compete keenly with us in the neutral markets of the world.

But at this stage we reach what may be described as the "avoidable" phase of the struggle, in the sense that relative commercial progress of the rival peoples is determined less by political and natural causes than by the operation of purely social forces. The determining factors have now become questions of education, organisation of masters, of workers, and the play of class claims and prejudices. There are, too, curious and distinctive differences in the motives which prompt the competing nations to commercial activity, differences which may be briefly summed up in the statement that in Great Britain individual wealth is sought rather as a means, while in America and Central Europe, where social and aristocratic barriers are less defined than with us, it is pursued rather as an end, and is proportionately more eagerly sought.

This, to some extent, explains the seeming indifference of the British master, and the freedom from trades union

restraint of the American and German workman. Both Lord Rosebery and Sir Henry Fowler join their voices to the consensus of mature opinion which points to education as the cure for this state of things. The British master requires education in methods; the British workman in mind. Great as have been the benefits secured to the working classes by the recognition and extension of trades unionism, the absence of a higher and more liberal education among them, such as exists in Germany and America, has led to the adoption by them of fatuous doctrines and economic heresies of which we are reaping the harvest in constant wrangles, on wholly insufficient justification, between masters and men. So long as British trades unions adopt the doctrine of artificial limitation of output in the interests of their class, while their foreign rivals do not, so long will our industrial position show yearly relative backsliding. But it is not the working man only who requires education. British merchants and captains of industry have yet to learn that only by a study of the demands of the world's markets, comparable with the pains taken to master them by our competitors, can they hope even to maintain Great Britain's position in the present, much less to regain its supremacy of the past. More organisation and interchange of information are required, and Lord Rosebery pointed to Chambers of Commerce as probably the most effective medium through which this can be secured. Traditions of individual action, of advancement by competition and self-help rather than by association or State aid, are so deeply ingrained into our British blood that we are slow to avail ourselves of the co-operative methods by which our neighbours reap advantage. In America there are the combinations of interests, assisted by practically unlimited capital, which, whatever may be said of them from an ethical standpoint, furnish resources and weight which are threatening to crush the individual and unorganised resistance offered to them by British firms. In Germany there is a spirit of mobility and enterprise, guided by aid from the highest quarters, and informed through an elaborate system of Consular reports as to the doings of competitors and demands of buyers, which is, carrying them far into the possession of the world's neutral markets.

But there is healing virtue in the very fact that we are, as a people, awakening to a sense of the position in which we stand. Of no branch of industry is this probably more true than that of electrical engineering, possibly because here the pressure of competition is most keenly felt. We believe that the problems which beset us are not by any means incapable of solution, and are prepared to hear that the lessons borne in upon us from within and without will lead to remedial measures in many directions, which will exonerate the British electrical industry from the reproach of indifference, and the risks of gradual extermination.

The Fall of Telephone Wires.

The extraordinary accidents resulting from the breaking of telephone wires at Liverpool—of which we publish an account elsewhere, are likely to give rise to an interesting discussion as to who is responsible. It would seem that the accident was primarily due to the breaking of the wires owing to the accumulation of snow upon them, but the real injuries were inflicted by the short-circuiting of the trolley wires, which the guard wires (if provided) failed to protect. Injuries resulting from the mere breaking of wires are not of frequent occurrence. In the absence of authority, it is probable that if the trolley wire of an electric tramway were to break and injure a passenger in the street, the company would be liable, provided it were shown that the accident was due to negligence on their part, or on the part of their servants. Where the short-circuiting and consequent damage is due to a broken telephone wire, different considerations arise. In Bedworth *v.* National Telephone Company [The Electrical Review, February 25th, 1898], an action was brought against a telephone company for the price of a horse killed by electric shock. It appeared that a broken wire, which fell upon the horse, short-circuited a trolley wire belonging to the South Staffordshire Tramway Company, who were joined as defendants. The County Court judge held that the telephone company were guilty of a trespass in allowing their wire to touch that of the tramway company, and held them responsible in damages.

Electrical Industry and Finance in the United States.—Mr. T. C. Martin writing in the *Electrical World and Engineer*, N.Y., estimates the capital invested in electrical industries in the U.S.A. as approximately £800,000,000. It is distributed as follows: telegraphy £50,000,000; telephony £60,000,000; electric lighting £240,000,000; electric railways £360,000,000; electric mining, power transmission, deposition and plating £50,000,000; electric manufacturing £30,000,000; automobiles and storage batteries £5,000,000. The total number of people employed in connection with these industries is estimated as 600,000. He considers that, in the new century, there will be no great development of telegraphy, but that there ought to be an enormous development of telephony, since only about 1 in 30 of the families in the U.S.A. use it, who are likely to have it before the century is out. America stands at the head of all countries in the world in nearly all branches of electrical industry, but European countries are likely to make up a good deal of the leeway within the next hundred years. Most of the above enormous development has taken place in the second half of the nineteenth century; with the splendid start it has got, it is difficult to imagine the development which will take place in the twentieth.

Wireless Telegraphy, Past and Future.—Discussing the past history and future development of wireless telegraphy in the *Electrical World and Engineer*, N.Y., Mr. Arthur V. Abbott gives the credit for the initiative to Lord Kelvin's demonstration of the oscillatory nature of the discharge of the Leyden jar. It is rather surprising for an American to overlook the claims of his own countryman, Henry, who, at an earlier date, showed that the Leyden jar discharge was oscillatory, and actually sent wireless signals from the top to the bottom floors of his house. In giving Branly the credit for the invention of the powder coherer, he also overlooks the claims of Varley, who, many years before, had discovered the carbon coherer, and completely explained its action when subjected to electrical impulses. Dr. Chunder Bose's investigations are mentioned by the writer, but what does he mean by his curious deduction, "that by a certain mixture of positive and negative substances, any degree of sensitiveness may be arranged;" surely the aim must be to increase the sensitiveness of coherers, and any mixture of positive and negative substances must reduce it. Mr. Abbott has little faith in the application of syntony in wireless telegraphy, notwithstanding the successful demonstrations of Marconi in England, and of Prof. Slaby in Berlin. There appears to be no prospect that wireless telegraphy will be used where wire telegraphy is possible, but there are many cases where that is not so. What is wanted is a portable Marconi apparatus that can be carried about the person, by which correspondents that are tuned to one another can talk to each other anywhere within 20 or 30 miles. Such an invention would be invaluable in military operations, but a system of wireless telegraphy which is thoroughly practical over *land* has yet to be devised.

A FEW NOTES ON THE CONSTRUCTION OF TELEPHONE LINES IN NORWAY.

By "BUSYBACK."

During a recent visit to Norway I was frequently struck by some of the peculiarities of the construction of the telephone lines. We have all heard of the great number of telephones and the cheapness of the Norwegian telephone service, but we have heard very little about the outside appearance of the lines. This article does not profess to be an exhaustive one on the subject, as it is the result of superficial observations taken on a holiday tour, with no thoughts

Fig. 1.

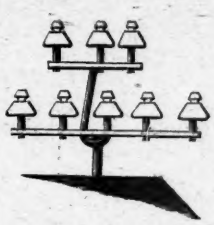


Fig. 2.

of publication at the time; and these observations must not be applied to the country as a whole, but only to the places mentioned.

We will commence with Stavangar, a town of about 10,000 inhabitants, situated on the south-west coast. The majority of the buildings are wooden structures; this allows of easier methods of terminating and supporting wires on them than brick or stone buildings would do. Instead of it being necessary to fix an iron bracket and bolt the insulator to it, as is the usual English practice, an insulator bolt, of suitable shape, is simply screwed into the woodwork of the house.

For over-house work the favourite method appears to be to fix an iron rod into the ridge of the roof, and to fasten an insulator on the top, while if two or more supports for wires are required such arrangements as shown in figs. 1 and 2 are used. These fittings are certainly not objects of beauty, and do not look so neat on the houses, with the wires on them, as they do in the drawings.

The standards for carrying large numbers of wires are made up in much the same manner, as the next sketch will show (see fig. 3). A second standard should be shown, almost at right angles to, and lower down on the roof than, the one sketched.

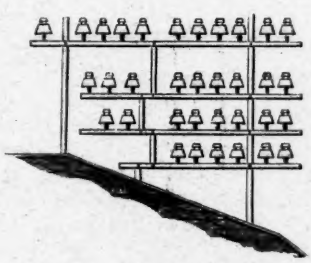


Fig. 3.

A drawing of one of the poles at Stavangar, made from a rough sketch taken on the spot, will give an idea of the appearance of some of them (see fig. 4). This pole was carrying 31 wires, and as it is a light pole, it is working to its full capacity; this seems to be recognised, as the six lower insulators appear to have been put on as an after thought, or because there was nowhere else to put them. They certainly gave the pole a most un-English appearance, especially the lowest insulator and its screw bolt. The pole itself is about 28 feet high, and of seasoned timber only; no trace of preservative was to be seen in this, or in any other of the numerous poles I saw. The top of the pole is fitted with an iron cap or ferrule and is provided with a bolt for a saddle insulator. The arms are of angle iron, and no two of them are of exactly the same length. The pole is not slotted for the arms, they are simply screwed or bolted on and braced together by iron uprights, with supporting pieces nailed on to the pole below. The poles do not appear to be earth wired. The insulators and straight bolts are all of one size and pattern; the insulators are of the double shed pattern, and are of white porcelain. The wires appear to be bronze, and are well regulated; with short spans, the poles being about 60 yards apart.

A pole for similar purposes to this one would, in England, be of creosoted timber, and would be slotted for the arms, which would be of oak; the ferrule would be replaced by a galvanised iron pole roof, and projecting above this would be the end of the earth wire to form a lightning conductor. The arms are sometimes braced together, but the supports from the bottom arm to the pole are very seldom used. The British Post Office have introduced tubular iron arms on their telephone trunk routes, but have found it advisable to place a strip of oak on the top of the iron arm to prevent their workmen getting shocks from the wires, through the iron arm being connected to the earth wire. This trouble does not appear to exist on the Norwegian poles, probably through there being no earth wire.

The outside construction of the telephone wires gives one the impression that a commencement was made with a few subscribers, and that the existing poles, standards, &c., were added to piecemeal, instead of having been taken down and

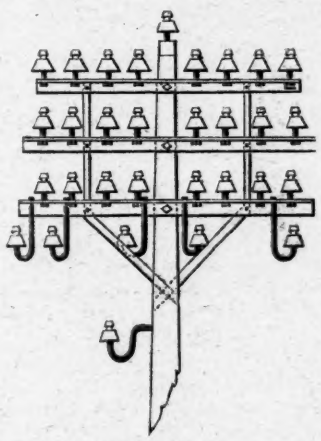


Fig. 4.

larger ones erected. The work has a much more flimsy and temporary appearance than similar work in England. From the size and appearance of the town, and the number of telephone wires, there appear to be a much larger number of subscribers to the telephone exchange than there would be in an English town of the same size and character.

At Molde, a seaside resort sometimes called the Brighton of Norway, the construction was of much the same character. Fig. 5 is from a photograph of a pole at the back of the cathedral; it will be noticed that this pole has iron arms kept at right angles to the pole by means of iron supports. It will also be observed that there is a saddle wire and insulator; and there is a wire and insulator supported by the curved bolt above the arms. The next photograph, fig. 6, shows a pole at the front of the cathedral, which is interesting, because the iron arms are supported on an iron upright fixed on to the top of the pole; this pole carries 25 wires, and certainly has a light and neat appearance.

An iron structure similar to the one on the pole is also used on house roofs. The method of house building is also fairly well shown in this photograph. The rough logs will be covered over with smooth boards, nailed to the projecting ends of the logs, which can be seen at the corner of the structure; these, when painted, will give the house a neat and tidy appearance.

Some of the work in Molde, near the smaller houses, on the outskirts of the town, is not at all neat; several of the untidy wires appear to be connected with the fire station and would probably be bell wires only.

D

Bergen, a town of from 65,900 to 70,000 inhabitants, had in 1897 about 1,800 subscribers to the telephone exchange. From the appearance of the wires, &c., I should say that the number has increased since then. One of the best looking pieces of work in Bergen is the open iron work pole in the Torvet, which, as will be seen from the photograph, fig. 7, is in the roadway of this fine main street. This pole carries 120 insulators, and is a substantial piece of work. There are several iron standards on the roofs in the distance which have quite an English appearance, and so do not need any description.

The next photograph, fig. 8, is taken from the fish market, and shows the wooden tanks in which live fish are kept; you can go to the market, choose your fish alive, have its throat cut on the spot and take it home, feeling sure that it is perfectly fresh! The thoroughfare behind is the northern end of the Torvet, or market square, one of the principal streets of the town. Wooden poles and aerial cables are not objected to in this street. There are four cables on the poles shown in the picture, and a plentiful crop of insulators are fixed on the neighbouring roofs, though they are hardly visible in the figure.

The last photograph is a view of Torvet Alimingen, showing the telephone exchange, or Telefonstation, on the right-hand side of the street. This photograph bristles with objects of electrical interest, as the telephone wires

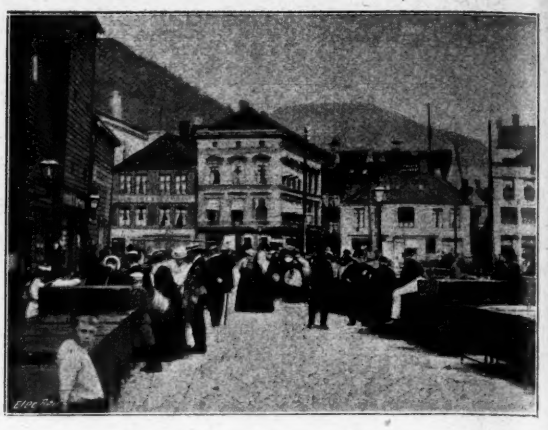


Fig. 8.

and cables, tramway supports, guard wires, and conductors are shown. There are no lamps on the standards;

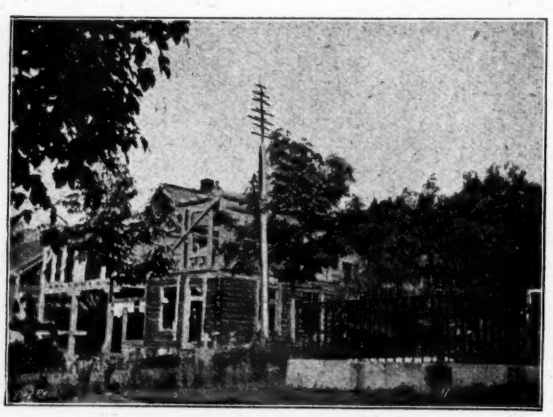


Fig. 6.

the reason for this is that it is summer time, and practically light all the 24 hours. The lamp, not being required for some weeks, is taken down and stowed away. Ordinary and incandescent gas and electricity are used for the street lighting here.

The main standard on the telephone exchange is very much the same as an English one would be in a similar position; it does not, however, appear to be large enough, and has been supplemented by the smaller ones at the side. In addition to the four aerial cables, a heavy bed of wires crosses the street at this point. The kiosk shown in the middle of the picture is also a telephone call office. There are several of these in various parts of the town.

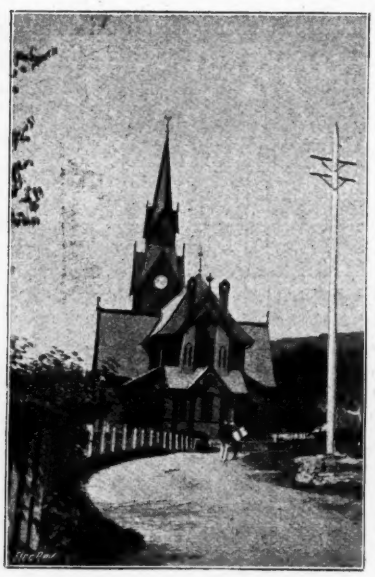


Fig. 5.

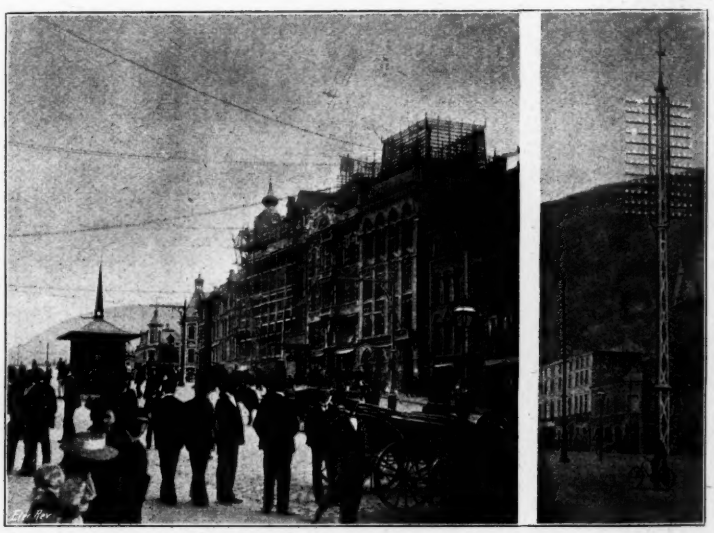


Fig. 9.

Fig. 7.

The number of street fire alarms connected to the fire stations is very noticeable in each of the three towns mentioned. The small standard for distributing the wires from the Bergen fire station is a circular structure, thus rendering it easy to take a wire in any direction. This form of standard is not often seen at home.

The cost of the telephone in Bergen is much lower than in England, the annual subscription being 68 kroner, or £3 15s. 6½d., for constant day and night service. The subscription is the same for town and country connections; country subscribers have, however, to pay for the construction of the line outside the city limits. The Bergen Telephone Company have no special wayleave rights. The concession to work and erect telephones is granted to them by the municipality, in return for which the municipality get their telephones at two-thirds of the ordinary rental; this is the only duty paid. The average length of the lines is 900 metres, or about 983 yards; they are constructed of silicium bronze wire. The instruments used are manufactured by L. M. Ericsson & Co., of Stockholm. The

capital outlay per line works out at about £13 6s. 11d.; at this rate the subscription will have to be paid for over three years to cover the cost of construction, to say nothing of maintenance. The company pays a dividend of 5 and 6 per cent., according to the class of shares. The service is said to be a good one.

It must be borne in mind that the telephone system of Norway and Sweden is conducted on different lines from the telephone system of England; the whole of the telephone service of the United Kingdom is practically in the hands of one company. In Norway and Sweden each town has a separate company with permission to work telephones, granted by the municipality, and in some cases a national concession for districts outside the municipal area.

The trunk lines between the various towns belong to the Government.

The rates in different towns are not uniform. In Stockholm, with 19,396 subscribers, and a population of 271,638, a charge of £4 8s. 10d. is made in addition to an entrance fee of £2 15s. 6d. In Christiania the same annual charge is made, but the number of calls must not exceed 6,000. In Bergen £3 15s. 6d. only is charged, as above mentioned. In several of the towns there are much lower rates for a limited number of calls.

From what I have seen of the construction of the lines, &c., they appear to be much more cheaply built than similar lines in England. In several of the outlying places the poles look as though they have been felled on the spot, trimmed, seasoned, and erected without any expensive cartage. A convenient rock or other support is sometimes made use of for carrying the wires. In the towns telephone poles are much more frequently seen in the streets than at home, while the fixtures on houses are not so strong and good as we are used to seeing every day. Wayleaves do not appear to be very troublesome; these considerations and the absence of a Government royalty make it possible for the companies to give a cheap and efficient service.

MACHINE TOOLS AND OUTFIT FOR ELECTRICAL MANUFACTURERS.

By W. H. BOOTH.

The earliest dynamos were excellent examples of the class of work turned out by poor plumbers working with unaccustomed materials. The close of the last century saw a complete change in many respects, and it cannot be denied that electrical machinery has been vastly improved. There still remains much room for improvement, and more especially is this the case with locomotors. Stationary motors have improved together with generators, but such machines as car motors are still far from perfect. They retain much crudity of form and design and great mechanical faults. Their arrangements for lubrication have received so little attention that the makeshift lubricator of 20 years ago is intended by their design, such material being some sort of lime soap, far from homogeneous, apt to melt into caverns and leave the box corners full of hard soapy matter. Grease lubrication is a failure, but is employed in order that the trouble of designing a suitable oil-lubricated bearing need not be taken. But granting the excellence of much of the electrical machinery manufactured, it still remains to be said that the system of manufacture is far from good—that is to say, the results may be good, but they are obtained at too great a cost, and the selling price of the goods is higher than it should be. Yet in many departments of electrical engineering progress has gone so far in the direction of good results, that it may be truly said that the time has come to standardise manufacture. Thus when an engine and generator tested with ordinary care and reasonably good instruments will show over 85 per cent. overall efficiency, it may fairly be claimed that granting reasonable errors of observation much more cannot be expected in the way of improved efficiency, and machines thus perfected may safely be standardised for manufacture. The multipolar traction generator is such an object for manufacture rather than for building. But the best of such machines are still built, as is most of the electrical machinery made in Great Britain and Europe generally. Americans probably claim to manufacture their electrical machinery, but experience with some quantity of it does not altogether uphold this claim. Design is perhaps fairly fixed in America, but interchangeableness is not.

To manufacture cheaply, two things are essential, quantity and method. The old idea of manufacturing cheaply in quantity was a very limited one. To obtain a dozen or twenty castings off one wooden pattern was considered to be cheap manufacturing. A dozen forgings ordered at once from the forge was thought to be a high economy, but there was, after all, very little economy secured in the workshop. Each engine bed was planed by itself, and the heights of the several planed parts were not nearer to drawing than could be measured by the foot rule or by a height gauge set from the rule. As this height gauge was separately set for each bed, and served for all the different parts, there was approximation of a coarse order, but no real attempt at exactitude. Now in modern work the parts, if suitable, will be largely milled off to height in the first instance, though they may be given a finishing cut on a planer, but there will be no time lost in setting the tool to the correct cut. The piece will be fixed on the machine, and the simple addition of stops on the tool slide will enable the workman to adjust the tool once for all heights. The difference of height between one surface and another is secured by inserting carefully gauged blocks between the stops. The workman's only care is to use the right gauge block for the various levels. This method is now more or less familiar, but is only a part, and a small part, of modern shop methods.

Electrical machinery is comparatively simple in its mechanical construction. A generator is a simple structure of bedplate, a plain circular frame, a shaft, and an armature. There is but one moving piece and a few adjustable pieces of the simplest order. Such a machine is, therefore, susceptible of cheap manufacture.

To this end its design as regards details may require to be slightly modified. A cheaply manufactured machine requires to be reduced to as small a number of parts as is consistent with goodness. It does not demand much difficult design to eliminate bolts that are required to pass through $1\frac{5}{16}$ inch of metal and $2\frac{1}{16}$ inch of metal, and design the lot for 2 inches, and generally too wide a variety of diameters of pins and studs will be abolished, and certain standard sizes will be adhered to. But when everything has been done in the direction of simplification, we have not more than touched upon the fringe of cheap manufacture. There can be no cheap manufacture without interchangeableness. The essence of cheap manufacture is to manufacture the details of any piece of machinery in large quantities, inspect each piece for accuracy, and pass it to the store of finished parts. From this store the details are drawn in perhaps smaller quantity, and put together to form a complete machine. It often happens that a machine is made up of many small details attached to one larger and heavy piece. The latter would require much room for storage, but would call for very little work in completing it, whereas the details require time, but will store in small compass. The ordinary lathe is a familiar example of this class of work. There may be a prospect of selling 100 such machines in a given time, and the principle of cheap manufacture demands that 100 of each detail part should be made in one lot, but the heavy simple bed may be wanted in various lengths. The bed may, therefore, be left unmade, for it is a piece soon cast and soon machined, and when successive orders for 10 or 20 lathes are received, the time for completion is narrowed down to that necessary to make the beds and attach the already finished details. Similar principles apply to electrical machinery, in the manufacture of which it must be sought to make at one time as large a number as possible, and to this end manufacturers should aim to confine their energies to narrower fields. A manufacturing engineer cannot now successfully cover the whole field of construction. American practice has, perhaps, taken the lead in this direction. There is at least one maker of lathes who makes, not only nothing but lathes, but only one size of that. He makes a lathe that fills well recognised duties, and if other duties are required that fall beyond the

scope of this particular lathe, the enquirer must go elsewhere. Others again, more diffuse, make several sizes of one machine only. In electrical work it would probably pay a modernised shop to make simply one size of car motor and do nothing else. To follow out this system what tools are necessary? In the first place, cheap manufacturing demands expensive outfits—not, perhaps, so much in the way of machine tools, as in the appliances to be used with them. It is of very little use buying a quantity of high-class machine tools if the appliances are not there to use with them. The basis of correct manufacture is the truly circular hole and the truly flat surface. The operation of making holes—usually known as drilling or boring, is now termed chucking. A piece to be chucked is operated on in a horizontal machine such as a lathe, or in a vertical lathe, such as a Bullard mill, which is like a lathe with a vertical spindle carrying a horizontal face plate. Such a machine will carry a heavy piece with ease; and the piece, once on the table, can be easily fixed. Gravity has not to be contended with. If small, the piece is first drilled through the solid, and if large, bored out with a single cutter fixed in a bar. It is next run through with a short four-lipped boring tool or pointless twist drill, and then a fluted reamer is put through it.

The finishing cut is done by an accurately adjusted reamer with movable blades, and this is a tool to be rapidly fed down. The essence of the operations is to bring the hole quickly to size within ·01 or ·02 inch, the small remainder being left for the reamers to remove. The completed holes when made must be gauged. Here we come in contact with the system of limits or tolerances. The essence of good and accurate manufacture is to make everything more or less inaccurate, yet so little wrong as to be better than carefully-made work by the old system.

To this end everything is made to two gauges. Thus, to a workman who is making bored holes, there is supplied a double ended hardened and ground steel cylindrical gauge. Having completed his cycle of operations he tests the hole with this double gauge. He must be able to pass one end through the hole with ease and smoothness. The other end must not enter. One end of this gauge has a diameter. it may be of 3·0012 inches, while the other end measures 2·9996. It is certain then that the bored hole is not four 10,000ths of an inch too small, and it is equally certain not to be twelve 10,000ths too large. The same system of gauging is applied to turned parts. For keying fits there are certain limits, and for running fits there are certain limits, and the turner has a double solid snap or jaw gauge, one end of which must pass freely over the turned piece, while the other end must refuse to go on. Now it only remains to select proper limits for all turned and bored parts to be interchangeable. Talk to an ordinary turner about the 4,000th part of an inch and he will disbelieve his own capacity to work to it. Give him two rod gauges that differ by that quantity and he will readily turn to the difference, for his skill is better than his ideas of exact magnitude. The system of limit gauges avoids all reference by the operator to sizes. He has his gauges and he has his drills, reamers, boring bits, or adjustable reamers handed to him from the tool room, and they are of correct size, and he uses them until the limit gauges begin to show a first indication that the piece is too big or too small, when it is his duty to apply for other tools. His safeguards are his gauges, and he requires no further aids. While a hole can be reamed out truly circular, it is less easy to turn truly cylindrical, and all truly accurate work, such as the journals of hardened spindles, is finished by grinding. This is especially necessary for such parts as are case-hardened, for they twist out of truth and must be ground to truth, for which purpose a little material is left by the lathe. The object of good machine work is to leave a minimum of hand work to be done. A file is only to be used on non-fitting parts.

Accurate surfaces are, of course, scraped to fit, but this applies rather to machine tool sliding surfaces and to the bearings of dynamos if of gun-metal. Fully to carry out the manufacturing of electrical machinery in the most economical manner, it must first be designed with a view to meeting these requirements. Parts must be capable of being machined cheaply, that is, by being amenable to the operation of the best working machines. Planing must so far as possible give way to milling, and the simpler forms must be chosen. The old preponderance of the lathe has gone. The vertical form of lathe has largely taken its place. On this machine a piece may be bored or turned as in a lathe, but much more readily.

Screw threads may equally well be cut on a vertical as on a horizontal lathe, but obviously the vertical lathe is a tool for short work, like fly-wheels or couplings or spiders. For work to be machined at several angles, it is better to provide a suitably divided index plate than to trust to division by change gears. For large surfaces, or bearing strips, milling machines are made of large capacity much in the form of planers. Some of these machines carry and operate three tools at once, the mill spindles being vertical and horizontal as well as adjustable. Where planing must be done, there are side planers—that is, machines with one side perfectly open to admit work that may project long distances beyond the machine table. Such a planer will be comparatively small, and suitable for light work, but will do the edges of wide pieces that cannot be put between the ordinary machine double standards.

The modern machine shop is distinguished by its method of driving. Its tools are all electrically driven. Small machines are, perhaps, best driven from a line shaft driven by a single motor. Larger machines are fitted with their own motors. In pursuance of the same idea, large work is now sometimes carried out upon ⊥-slotted and planed cast-iron floors, and in place of taking work to the machine tool, the tool is brought to the work. Electrical driving is particularly applicable to this arrangement—indeed, is the cause of the arrangement having been adopted. The future will see the truly skilled mechanic considerably advanced in position and responsibility. It will also see the position of the shop labourer improved. No longer will it be a crime, even in the eyes of the trades unions, to take a labourer and allow him to double his wages by attending to machines set up by skilled mechanics. It will be fully recognised that unless the English labourer be allowed to do this, the work he is refused will not be done in England at all, simply because a skilled man's wages cannot be afforded on such a class of work. The work will go out of the country if not done by our own labourers.

The electrical manufacturing shop will be a clean place and totally unlike the old-fashioned grimy den so many of us recollect in the days of our apprenticeship. It will be suitably warmed to 55° or 60° and properly ventilated, and every worker in the shop will have his own wardrobe and washing facilities. Probably the ranks of gentility in the shape of badly-paid clerks will be considerably depleted when there are many such shops, because with facilities to be decent and clean there are many clerks who would make good and intelligent machine workers, and find the work infinitely easier, and better paid than quill-driving in a dreary office. English tool makers have fallen greatly into arrears. True, the primary cause has been the stifling efforts of the unions, but the employers have themselves to blame for the fact that the unions have been made up of such men as have controlled them, for few shops have paid the slightest attention to the decencies of life, and no decently dressed man has even had a clean square foot of space in which to keep a change of attire, much less any facility for washing or comfort of even the meanest order. It appears to us that given such facilities there are many clerks who would be glad to exchange the drudgery of an office for the atmosphere of a really well-ordered machine shop, in which they might find some advancement. This is but one of the many directions in which the future practice may depart from the present. In other directions there are changes in the methods of doing work. The lathe with its single tool is still unrivalled in certain directions, but for much of the work done on it, it is costly and unsuitable. Flat surfaces hitherto done on the lathe or planer may be done more cheaply by a milling tool, and in a modern shop large milling cutters several inches diameter with inserted teeth may be seen travelling over flat work at a feed of 7 inches a minute. Hand wheels, gear blanks, and other articles of circular cross-section are now rotated slowly against the face of a formed milling cutter, where formerly they would be laboriously cut in a lathe with a single cut. Within an hour or two of writing this the writer

has seen six circular milling machines in the charge of one young man. His duty was to keep the machines going, and without haste or hurry he often had all six in full work, and only less than six when two jobs happened to run out together. This one man was doing the work of 12 lathes and 12 men.

Turret machines again, which are but a form of multiple tool lathe specially designed for repetition work, are essential to good and cheap production; while the same machine, with wire feed and entirely automatic in action, is essential to the cheap production of the many small screws, and other small parts used in all kinds of machinery. A truly cylindrical spindle or shaft cannot be produced on the best lathe, and no high speed engine should be made in which the shaft bearings are not ground to truth. Grinding consists in slowly rotating the work against a rapidly revolving emery or carborundum wheel. There is no pressure between wheel and work; the wheel removes simply such parts as stand above the general level, and tones down the whole to one true surface. The gun-metal bearings in which such spindles or shafts revolve are internally ground, and the last final operation of hand-scraping of the bush is reduced to a minimum. Not only will the future see individual manufacturers working to the limit gauge system, but in many cases it will find him making to certain standard dimensions, so that his 50 KW. motor will interchange with those made by others. When all this has been accomplished, machinery will be better and cheaper. It will be applied to more of the operations of life, and will finally result in easier lives, shorter hours, and better surroundings for all.

To-day everyone is working double the hours that should be necessary to turn out an equal product. Modern shops are doing work at half the cost of many of the older shops. When one realises how, with old methods, which to-day are no methods, Great Britain is, after all, not very far behind in the race, owing to her unrivalled resources, position, and natural energy, it becomes apparent how, in a few years' time, she may easily regain the ground lost, and place herself at the van once more. All that is required is a frank recognition of the modern methods of doing work, combined with scientific and correct technical knowledge.

English workshops are very backward, backward in their tools, in their methods, organisation, and general equipment, and they are backward in their men, who, because they have obeyed the trades unions, and forbidden the labourer to improve himself, have failed to secure the jobs for themselves, and handed them to the foreigner. Free to use their own instinct of competition and self-preservation, the workmen would demand of their employers the adoption of the modern system.

One of the great aids of the modern system is the jig. The term jig covers a wide range of articles. In brief, a jig is an article to which work is attached, or which is itself attached to the work with the object of facilitating the performance of machine work. Thus if a casting is to be accurately drilled in several places, it will be difficult and laborious to lay out each hole in its proper place and drill it with accuracy. But we may make a jig to help us. This may be a box to hold the piece to be drilled. In the sides of the box are holes fitted with hardened steel bushes, through every one of which the proper size of drill is passed. Obviously, the piece rigidly held inside the jig will be similarly drilled. Once we have our correct jig we can cheaply copy it by hundreds. In manufacturing machinery there are jigs or special fixtures of this and similar descriptions for almost all details, and the tools and appliances that are prepared to make a single machine may be more bulky than the machine itself. Once made, however, and the question of machine manufacture is simply the operation of machine tools by the aid of the appliances. To prepare jigs and tools it is requisite to employ men of skill, but labourers can do all the rest. Brought to simple language, the past policy of the trades unions has been to forbid the labourers to operate the machines, and thereby they have deprived the skilled men of the opportunity of making the jigs, &c., work which does demand skill.

Thus the possession of modern high-class machine tools is one part only of the modern system of manufacture. This economical employment is a question of accessories and of means of instantly applying such accessories to perform accurate work. But given the accessories in the form of jigs, the tools to be used must be good. Machine manufacture is based on the boring of holes to correct size and in a correct place and direction. As the boring of a hole cannot be finished at one operation, we see how important it is that the series of boring tools employed shall bear a correct proportion to each other in diameter, so that as an operation approaches finality, the final tool employed has almost no material to remove.

An example of an expensive tool applied to an apparently trivial work, is the large and heavy cutting press that stamps out sheet-iron discs and segments for armature cores, &c. These embody expensive dies and heavy frames, but they produce discs of identical size demanding no hand work of any moment when assembled. Similarly in place of slowly and laboriously slotting the seats of the field pole-pieces upon the frame of a generator, the future should see all these bored out in a fraction of the time now consumed. It is characteristic of old methods that the labour cost of parts is out of all proportion to the weights. In many small things this disproportion still holds to some extent, but it is in this direction that endeavour should be directed towards cheapening, and when this has been successfully accomplished much of the spirit of modern machine manufacturing will have been absorbed.

TRAMWAY GAUGES.

[COMMUNICATED.]

There are three principal tramway gauges prevalent in this country. They are 4 feet 8½ inches, 4 feet, and 3 feet 6 inches. There are doubtless others, but the very mention of three ought to be alone sufficient to show the confusion with which the industry is saddled. In the early days of railways there was some excuse for the multiplicity of gauges which existed, because there was no general appreciation of the vast growth of the railway industry, nor of the rapid approach of the day when a break of gauge would prove so costly. Long enough before the Great Western Railway abandoned its 7-foot gauge it had been compelled to adopt the third rail system, so as to provide for through traffic, and for years the company built their new engines and cars in such a manner that when the broad gauge was finally abolished, all modern stock could be placed on standard axles or frames, so that the final change was well prepared for; but, nevertheless, the original error in choice of gauge was long a heavy tax on the company. We say error, not because it was necessarily an error, but because it was made so by the standardisation of the narrow gauge, just as all but one of the numerous tramway gauges will be put out of Court by the final standardisation of one gauge.

Is it not a matter of surprise that with all the lamentable and costly experience of the railroads, there should be at this late day a repetition of the error on the part of the tramways? The fixing of one gauge, and one only, ought to have been long ago the prerogative of the Board of Trade. We do not pretend to say what should be the gauge adopted. There is much to be said in favour of the standard railway gauge of 4 feet 8½ inches, the chief argument in its favour being that it is standard, and would some day enable the steam railroads to interchange vehicles with the tramways to a certain extent.

But considerations connected with rail grooves, width of tread, and so on, may be advanced to show that perhaps, after all, this argument may be pushed too far, and that the expense of the wide gauge is not likely to find any countervailing advantage in the possible interchange. The most usual tramway gauge at present is probably the 3 feet 6 inches. This is a very convenient gauge; it does not fill the streets too much with the wide vehicles that would inevitably be built were a wide gauge adopted. On the other hand, this gauge provides a very narrow space between its wheels for containing motors, gears, and so on, and the

packed appearance of the truck of a 3 feet 6 inches car is rather apt to make the observer turn favourably to a wider gauge. Yet the 3 feet 6 inches gauge has, so far, been fairly satisfactory, and there are advocates for even the narrower gauge of 3 feet, just as there are advocates for 4 feet, or any other gauge. But it may be said with truth that any of the gauges would serve, and if selected would be better than the mixture into which the country is drifting for lack of some strong authority which should fix the standard and permit no departure therefrom.

The confusion of the horse tramway gauges has been perpetuated successively through the era of steam traction down to the era of electricity. The anxiety to keep traffic going may have had something to do with the matter, but has been allowed to exert too much sway. It should not be allowed any weight in face of the desire to reduce an odd gauge to standard. The present advantage is not worth the charge in perpetuity that it may involve. The narrow and one-horse view still held of tramways is only too painfully apparent in the struggle of so many pettifogging communities to control the lines within their own areas, and to overlook the broad question of interurban traffic, so that the spectacle is seen of adjacent towns with different gauges—a repetition of the different gauges of the railways of the three adjacent Colonies of New South Wales, Victoria, and South Australia, not to mention West Australia or Queensland.

The question of gauge is one that might well be taken up before it is too late. Indeed, it is already late, but better now than when a greater mileage has been laid down. It might fitly form a question on which the Tramways and Light Railways Association could expend some energy and so lead to the subject being placed under a hard and fast rule—a compulsory gauge for all new construction. Such a compulsory rule would not be in existence long before all lines would begin to conform to it, and the non-conforming gauges would come into line as they came to need reconstruction. The economy would be great, and the present confusion of dimensions and types would disappear. In tramways, as in railways, it can be fairly claimed that one badly selected standard is better than half a dozen well selected standards. A rough examination of various systems shows 37 with standard gauge, 10 with 4 feet, 25 with 3 feet 6 inches, and seven with 3 feet. The proverbial wisdom of Glasgow comes out in the folly of 4 feet $7\frac{3}{4}$ inches, and there are gauges of 2 feet 3 inches; 2 feet $8\frac{1}{2}$ inches; 2 feet $11\frac{1}{2}$ inches and 5 feet 3 inches; the last is the standard Irish gauge. These gauges we pick out of a list of all lines. In both number and length, as well as in their general importance, the 4 feet $8\frac{1}{2}$-inch lines come a long way ahead, especially if to the list be added the lines that conform to the Irish standard gauge. Of light railway orders so far confirmed by the Board of Trade, the standard gauge is well to the front. A study of any list of English lines affords convincing proof that the promotion and construction of tramways in this country are still governed by exploded ideas, and marked by lack of foresight and energy of a most lamentable order.

REVIEWS.

American Telephone Practice. By Kempster B. Miller. New York: *American Electrician* Company, 120, Liberty Street.

This is a volume of 511 pages of large quarto size, purporting to cover the whole field of telephony as practised in America. In the preface the author observes that he . . . . "has endeavoured to present in as clear a manner as possible the general principles of telephony, the design and construction of commercial apparatus, the circuits connecting such apparatus into operative systems, and the methods used in the construction, operation, and maintenance of these systems."

It cannot be said that the book altogether fulfils the expectations aroused by the preface. When a book reaches its third edition in three months, it is a proof either that it possesses acknowledged excellence in itself, or that it breaks virgin soil: it may even be a proof of a claim to both of these distinctions. In the domain of telephony we hesitate to describe this as an excellent work: it is certainly not a good text-book; but that it breaks some new ground over a wide area, there is no room for doubt.

Of all modern developments, few have assumed such magnitude in America, and none promises such expansion in the United Kingdom, as that of telephony, yet none is so poorly furnished with up-to-date text-books. It is true there is in this country a work of some 500 pages by Preece and Stubbs, but it is out of date; and there is another of more modest dimensions by Poole, but it also needs bringing up-to-date. In America there was no telephone book of any merit in the market until Mr. Miller's work appeared.

There are many American telephone experts capable of giving, and doubtless willing to give, to the world a text-book on telephony, but they are prevented from so doing by their employers. Mr. Miller appears to be a free lance. But this very independence has its drawbacks, and no doubt it accounts, in some measure, for the meagre descriptions given by its author of some of the best and most modern telephone installations, as well as for some antiquated matter.

It is impossible to read through the pages dealing with certain departments of telephone work without coming to the conclusion that the writer has but a limited practical experience in telephone engineering. Much of the matter has about it the ring of a patent specification, being of a comprehensive and rather general character. We get the broad general principles of many parts of the subject, instead of exact working details, which would be of far more value to the student: this is one reason why we do not consider it a good text-book. But this much must be said, that there is a good deal in the work which has not previously been published; and all the matter, except what is antiquated, is interesting as well as instructive.

Three months ago a copy of the first edition was placed in our hands for review, but before our review was ready the third edition came to hand; we shall therefore review this edition. Viewing the book as one of much interest to a large body of our readers, giving to English telephone engineers valuable information not hitherto contained in any work on telephony, we shall indicate, rather fully in some cases, the subject matter of each chapter, and while a full criticism will probably prove useful to our readers, it may induce Mr. Miller to introduce into his book improvements which shall render it more instructive on both sides of the Atlantic.

As is usual in works of this class, the early pages are reserved for the historical part of the subject. The first and second chapters are devoted by Mr. Miller to the history and principles of the magneto telephone and the battery transmitter respectively, the information, useful in itself, being furnished very succinctly.

Chapter III. deals with receivers, all of the Bell type, and the descriptions are detailed and clear. With regard to their construction, the author, arguing with much force, is of opinion that it is poor construction—(1) to secure the magnet in the shell at the end furthest from the diaphragm; (2) to secure it rigidly near the diaphragm and at the opposite end; and (3) to use in vital portions of the instrument any of the materials imitating hard rubber.

To some extent American practice, so far as receivers are concerned, differs from English. The fixing between the magnet and its case is made close up to the pole-pieces, and the adjustment is capable of alteration, and the form of the case itself differs somewhat.

Chapter IV. is devoted to carbon transmitters. The granular transmitter has no rivals even in America. Several forms, differing from each other in small details, are described. The only form calling for special remark is an instrument designed to produce actual alterations of current in the primary. It has recently been patented by Messrs. Payne & Gharky, of Philadelphia, and powerful results are claimed for it. There are five electrodes, two of which are

connected together and to the diaphragm by a sort of piston rod, and are movable between the other three. Granular carbon is placed between each pair of electrode faces.

Chapter V. treats of induction coils, but brings before us nothing new.

Chapter VI. deals with primary batteries. The usual Leclanché and Fuller's bichromate cells are described, as well as a form of Gravity Daniell. A new cell which has recently come into extensive use for certain classes of telephone work deserves some notice. This is the Gordon cell, manufactured by the Gordon Battery Company, of New York. Briefly, its features are: A negative element, consisting of a perforated tin cylinder filled with black oxide of copper, which is a powerful depolarising agent. Three porcelain lugs are attached to the lower portion of the cylinder, and upon these rests the positive element, also of cylindrical form. Its substance is amalgamated zinc, and its dimensions are: diameter, 5½ inches, width, 2½ inches, and its weight 1½ lbs. The electrolyte is a strong solution of what the manufacturers term "electro-sodium"—probably caustic soda. The electromotive force, which is constant throughout the life of the cell, is very low, being about ·66 volt, but its resistance is also extremely low, being only ·04 ohm. The cell has a capacity of 300 ampere-hours when discharged at a rate varying from 1 to 6 amperes. Larger sizes are made with capacities as high as 1,000 ampere-hours. The cell is well adapted for closed circuit work where a small steady current is required for a long time. It requires little or no attention until completely exhausted, does not freeze at ordinary temperatures, and is free from local action. It is frequently used as a reserve battery in small exchanges with common battery to supply current in case of failure of the storage battery. But the low E.M.F. means a big installation, and this in turn means space, which in this country, at least, is not easily procurable, and is generally an expensive item.

Chapters VII., VIII. and X. deal with calling apparatus. Magneto-generators, automatic cut-outs, bells, &c., are all dealt with at length, and it is noticeable in Chapter X., as indicating the trend of modern practice in the direction of doing all ringing from the Exchange, that a considerable portion is devoted to power generators.

In Chapter IX. the hook switch and the circuits of a telephone are dealt with. Various switches are described, and the connections of a number of telephone sets are shown, but no new feature is brought before us. Concerning contacts, the author emphasises the necessity for all, save those of platinum, being of a rubbing nature. In Mr. Miller's opinion, German silver springs bearing on brass contacts make the best combination, and he points out that in no case should the contact through the pivot screw of the lever be depended upon.

In Chapter XI. an interesting *résumé* is given of what has been done by experimenters towards devising a serviceable form of telephone repeater.

Chapter XII. merits special commendation. It is devoted to a consideration of self-induction and capacity, and their effects upon undulatory currents. This, and the succeeding chapter on "Telephone lines," besides treating of earthed circuits, common return circuits, and translators, deals with inductive disturbances and their elimination. These matters are given an amount of space which their importance merits.

Chapter XIV. describes several forms of simple switchboards for small exchanges, but calls for no comment.

(*To be continued.*)

Science Abstracts. Vol. III. Edited by W. R. Cooper, M.A., B.Sc. London: E. & F. N. Spon, Limited, 1900.

The completion of the third volume of this invaluable literary sketch-book, so to speak, is brought to our notice by the arrival of the index. The volume for 1900 comprises 2,525 abstracts, as compared with 2,000 in 1899; the increase is no doubt due in part to the inclusion of steam plant and automobiles, but by far the greater part is evidence of the steady widening of the field of operations, thanks to the incessant progress of the scientific treatment of industrial operations and of scientific research in all countries. The fact that the number of journals reviewed is but little greater than in the preceding year supports this view.

Anything like a review of the past volume would be a herculean task, after the order of reviewing an encyclopædia; but in point of fact, no such review is needed. *Science Abstracts* may now be considered firmly established as a work of reference indispensable to engineers; it is one of those things that fill a void so well, that their existence is looked upon as part of the order of Nature; we can only wonder how we got along in the benighted ages prior to 1898, when *S.A.* was not! Mr. Cooper and his staff (now numbering 66) are to be congratulated upon the success which has crowned their arduous labours.

ELECTRICAL WORK AT THE GLASGOW INTERNATIONAL EXHIBITION.

On Thursday last week Mr. Thomas Young, engineer and electrician of the Glasgow International Exhibition, lectured to the members of the University Engineering Society on "The Engineering and Electrical Work of the Glasgow Exhibition, 1901." After detailing the engineering side, Mr. Young invited the consideration of his hearers to the electrical department, which, by some, might be considered of the greater interest. The generating station and plant, the lecturer said, is erected at the south-west end of the Machinery Hall, and consists of 12 sets of combined steam engines and dynamos, giving a total output at the terminals of 4,176 E.H.P. Five of these dynamos are working at a pressure of 500 — 530 volts at the terminals, and seven at a pressure of 250 to 265 volts. This range in the voltage is allowed in order to provide for loss in transmission to the various stations or points of distribution through the various sections of the Exhibition. Three of the dynamos are compound-wound, but all are used as shunt-wound machines, and coupled up to the bus bars of the main switchboard on the parallel system. With compound-wound machines (apart from other considerations) the method adopted for connecting them in parallel is more complicated, and requires extra switch gear, &c., so that a machine may be switched in as the load increases, or be switched out as the load decreases, without the risk of changing the direction of the current in the windings (or polarity of the magnets)—a contingency which is easily overcome when shunt machines are used.

The main switchboard consists of 15 panels of polished and enamelled slate slabs, and measures 31 feet 9 inches in length by 7 feet in height. Upon these slabs and in front are mounted the regulating, controlling, and recording gears, and connected to the respective bus bars which are mounted at the back of the slabs. Each dynamo is connected to the bus bars of the main switchboard, through an automatic magnetic circuit break switch, amperemeter, shunt regulator, and double-pole fuses. The main switchboard is also fitted with the necessary feeder logs, earth recorders, direct reading and recording volt and amperemeters, electricity meters, circular dial timepiece, &c. The shunt regulating resistance frames are placed in the space behind the switchboard and connected by means of suitable links through the slate slabs to graduated handles in front, so that each can be easily operated by the attendant. The distribution stations are seven in number, six being arranged as follows:—Two in the Machinery Hall at the north-west and south-west ends, one in the Grand Avenue, and three in the Industrial Hall. From the above stations all arc and incandescent lighting is controlled.

The incandescent switch and fuseboards are separate from the arc switch and fuseboards, both in the manner of erection and supply. Each arc or incandescent switchboard is fitted with two double-pole quick-break change over switches, connected by an insulating link to form one change-over main switch, and the necessary number of single arc circuit switches with double-pole fuses, or double-pole incandescent sub-main switches with double-pole fuses, as the case may be. The arc circuit regulating resistances are mounted upon angle iron frames, 10 inches clear of walls, and behind, or conveniently near to, the respective switchboards.

The various sections of the Exhibition are lighted by means of Brockie-Pell 10-ampere arc lamps of various types, and incandescent lamps of various powers. In the main buildings, the arc lamp is adopted for general lighting, running 10 lamps in series on a 500-volt system; for all other buildings the arc lamps are run five in series on a 250-volt system. Generally speaking, the arc lighting is calculated and arranged on the basis of 750 square feet of floor space for each 10-ampere arc lamp. The general height from the floor level to the centre of arc in the main buildings is 23 feet, and in other buildings about 12 feet. The wiring of these arc lamps is so arranged that every alternate lamp is connected to a different circuit, so that in cases where a particular lamp or circuit happens to get out of order, the general lighting of that portion of the building will not be seriously affected. In addition to the arc lighting of the main buildings, there is also a complete pilot system of incandescent lighting, arranged so that all the principal passages, &c., can be lighted direct from the Corporation supply. The main cables, which are supplied and laid by the British Insulated Wire Company, Limited, Prescot, are low tension triple concentric cables, class A, insulated with impregnated paper and

lead covered. These cables are seven in number, each having a sectional area of inner copper conductor of ·25 square inch, and overall diameter of 1·73 inch, and are laid in a wood conduit beneath the flooring, between the main switchboard and the various sub-stations and switchboards, the total length being almost 4,000 yards. The lead covering of these cables will be metallically connected together at several points and the whole connected to earth. The voltmeter pilot wires are also lead-covered and run in the same conduit as the main cables.

Each sub-station switchboard is fitted with change-over switches, and can be supplied from either the Corporation or the Exhibition supply. Of course it is not expected that the whole Exhibition system will be thrown on to the Corporation supply, even for a short time, the object of the reserve being to compensate for any slight deficiency that may take place during the running of the Exhibition plant, and more particularly to have a completely independent supply for the pilot system of incandescent lighting throughout the various sections. To ensure the last object the main cables are duplicated at various points, and an extra length of 403 yards of ·25-inch triple concentric class A cable laid down, in addition to other cables of smaller sizes. The branch main cables and sub-main cables, also supplied by the British Insulated Wire Company, are laid in wood conduits beneath the flooring or run overhead fixed upon insulators between the sub-switchboards and the distribution fuseboards.

The arc circuit cables for the main buildings, supplied by Messrs. Frankenburg, Limited, Salford, are run overhead between the distribution fuseboards and the various lamps, resistances, switches, &c., fixed upon insulators, or enclosed in wood casing or iron tubing, according to the nature of the particular section. The incandescent wires are run between the distribution fuseboards, and the various lamps, switches, &c., are enclosed in wood casing or iron tubing.

A searchlight, supplied by the British Schuckert Electric Company, is to be erected on the dome of the Grand Concert Hall. It is fitted with parabolic glass mirrors 1,500 millimetres in diameter, and the lamp and equipment is regulated by two small electric motors. The weight, complete, is nearly 1½ tons. The electricity working the searchlight is taken from the Corporation supply—85 amperes at 500 volts, and transformed to 150 amperes at 110 volts, the pressure required for working the light.

Many of the exhibitors will show machinery in motion driven by electric motors. In the Machinery Hall there are over 60 motors, in the Grand Avenue three, and in the International Hall a like number. These range in power from ¼ to 150 H.P. Two electric cranes are used in the unloading of exhibits, one at the railway siding loading bank, a joint exhibit by Messrs. James Carrick and Sons, Edinburgh, and the British Schuckert Electric Company. The other, which has a lifting capacity of 3 tons, is situated in the goods yard at the Industrial Hall, and is provided by Messrs. Wimshurst, Hollick & Co., Limited, South Fambridge, Essex. Both cranes are supplied with electricity from the Corporation mains.

The lecture, which was profusely illustrated with lantern slides, was greatly appreciated, and at the close, Mr. Young was cordially thanked.

THE FALL OF TELEPHONE WIRES AT LIVERPOOL.

On Monday afternoon snow fell heavily in Liverpool, the fall increasing towards evening. Great interest was manifested in the working of the electric tramways system, as there had not been any previous heavy fall of snow since the extension of the system to its present dimensions, and wonder was naturally excited as to how the system would work with a heavy coating of snow on the track. As a matter of fact it worked without any serious hitch, though the cars in their progress had to push a considerable weight of snow before them owing to the heaping up of the snow by the life-guards as the cars moved on. A serious and fatal fall of overhead telephone wires, however, occurred, and caused a cessation of the electric car service on some important routes, and a general stoppage of street traffic in the vicinity of the scene of the accident. At six o'clock the fall of snow became exceptionally heavy. Shortly before seven, a stack of telephone wires crossing the wide part of London Road and Pembroke Place at right angles, fell to the street, coming into contact with the overhead trolley conductors in their fall. The accident was, no doubt, due to the heavy accumulation of snow on the bunch of wires over one of the widest spans in the city. The pedestrian traffic is greatest about seven o'clock at the point of the accident; several persons were consequently caught by the wires and entangled among them in a distressing manner. Every assistance was rendered to those who were so unfortunately placed, ropes being used in some cases in the endeavours to free them from the tangle of wires in which they had become ensnared. One of the sufferers—a Mr. T. W. Singleton, of Liverpool—was dead when finally released. A second man, named Thomas Hankey, a carter, who was proceeding with his horse and cart along Gill Street, which lies almost longitudinally with the line of wires which fell, was also killed. In his case, his horse was struck by the falling wires, and fell to the ground. Hankey went to the animal's assistance, and, it is supposed, received a heavy electric shock, as he succumbed in a few minutes. A second horse which was passing along Gill Street, received the full force of the falling wires on its back, and was killed on the spot. A third horse, which was in Great Newton Street, which lies parallel with Gill Street, was also struck by the fallen wires and killed. About 13 persons are known to have been injured by the fallen wires. In all of the cases the injuries are reported as burns, or burns and shock.

Through falling on the live wires of the electric car system, current was imparted to the fallen wires, and vivid discharges of electricity went on for some time, causing great consternation among the large crowd of people which had assembled near the line of accident, and increasing the terror of the unfortunate people who had become entangled. At a late hour Mr. Bellamy, the manager of the tramway's undertaking, stated that the wires of the electric tram system had not been broken or fallen at all, and that a second bunch of between 20 and 30 telephone wires had also fallen in Lodge Lane, a mile and a half from the scene of the fall above referred to, but that in the case of the Lodge Lane wires they had been cleared without personal injury. The overhead wires at Liverpool are controlled by the National Telephone Company. This company has lately been substituting an underground conduit system for the overhead system, but a large area of overhead wires is yet in existence. For some time after the electric car traffic was resumed the running was irregular, owing to the irregular demand made on the supply, many cars having been stopped in groups and an excessive demand being made on the supply on starting.

An official police report of the occurrence has been made. It states that at 7 p.m. on the 4th inst., a number of telephone wires crossing Islington, London Road, Pembroke Place, and the adjacent street, collapsed, presumably with the weight of snow, that they fell on the overhead electric conductor and that the current was transmitted straight to the broken telephone wires. A great number of persons, the report states, were leaving town by these thoroughfares, and some of them became entangled in the broken wires and received electric shocks. The report details assistance rendered by the police, and that during their efforts to extricate the persons who had been caught by the wires, three constables received electric shocks. It states that messengers were sent to the tramway offices, Sir Thomas Street and Pudsey Street, to the Highfield Street generating station, and to the telephone company's offices, Exchange Buildings, in order to get the current shut off. Owing to telephonic communication being destroyed messengers had to be despatched to these centres on foot. Mr. Bellamy, general manager of the tramways, Mr. Mellins, traffic superintendent, and a force of tramway employés were quickly on the scene, and Mr. Bellamy at once took steps to have the main current of the car system cut off.

The officials at the offices of the National Telephone Company, Liverpool, are naturally reticent about the disaster, and at the present time could probably add little to the main facts of the case as already stated. Mr. E. J. Hidden, the Liverpool manager for the company, has expressed the opinion that the accident was due to the snow on the wires, and that a good many poles were reported to have fallen at different parts of the city from the same assumed cause. The manager has further stated that the company were at the present time removing the overhead wires where they crossed the tramway wires, but that this work would necessarily take time.

The accepted explanation of the fatalities and the injuries received by those persons who were caught by the fallen wires is, that owing to contact with the main supply wires of the electric car system at a point near one of the feeders, the fallen wires received a heavy, and, for a time, continuous charge of electricity, and that it was the electricity and not the falling of the wires or their weight which caused the death of the two persons, and of the horses, and caused the injuries to the injured persons. The report from the Royal Infirmary, where two of the injured persons remained, supports the explanation given. Sixteen persons in all were treated at the Infirmary after the accident, but 14 of them were able to proceed to their homes.

LEGAL.

Harburg India-Rubber Comb Company and Another *v.* Martin.

In the High Court of Justice, King's Bench Division, before Mr. Justice Mathew, January 28th, 1901.

This was an action brought to recover damages for breach of an agreement to endorse acceptances for a sum of about £393. The answer of the defendant was, first, that no such contract was ever made; secondly, that if it was made, it needed to be in writing, under Section 4 of the Statute of Frauds, as being a promise to answer for the debt of others. The plaintiffs are manufacturers of materials used for electrical purposes, and upon the introduction of the defendant they had supplied goods to the amount above mentioned to the Crowdus Accumulator Syndicate, which had been formed to work patents for the manufacture of materials connected with the storage of electricity. The syndicate had used this process, but not very successfully, and found themselves unable to meet their obligations, so that the plaintiffs, among others, were obliged to bring actions against them. The plaintiffs recovered judgment, but before this was put in force, the defendant (chairman of the syndicate) called on Mr. Winter, who represented the plaintiffs, and entered into the alleged agreement. The jury decided that the defendant's evidence could not be acted upon against that of the other two witnesses, and found upon the question of fact a verdict in favour of the plaintiffs. The question arising under the Statute of Frauds was argued before the judge on Saturday, January 26th, and came up for judgment on the 28th.

The Judge said that apparently the defendant said to Mr. Winter: "The effect of issuing execution and sweeping away the goods will

be to destroy the company." He was himself a shareholder to the extent of £5,000, and other members of his family were interested in the company. What he wanted was time, so that he could secure the sale of the company or raise fresh capital. The defendant offered a bill at six months to be endorsed by him and by his brother, the debenture holder, but Mr. Winter objected to that, and said that he would accept two bills, one for three months and the other for six months. According to the finding of the jury, the defendant agreed to this, but the bills did not come to hand, though Mr. Winter repeatedly wrote to the defendant for them. As time passed, and nothing was done, the present action was brought. At the time when the defendant came to Mr. Winter, the plaintiffs were in a position to take possession of the goods—a position analogous to that of persons having possession of them. Cases were cited by his Lordship bearing on this point. The object of the arrangement was to protect the goods, not to pay the debt of another; this alone was sufficient to take the case out of the Statute of Frauds. But the promise was given for the purpose of obtaining a direct personal advantage for the defendant, who pointed out that he had invested £5,000 in the company, which would be lost unless time was given to the company to get on its legs. Clearly, therefore, the Statute of Frauds did not apply. A further argument was that if the contract had been completed, the endorsement would have been valueless, and only nominal damages should be awarded to the plaintiffs. This point was disposed of by reference to cases cited, and judgment was given for the plaintiffs for the amount of their claim and costs.

Leave was given for a stay of execution on the usual terms, with a view to appeal.

Barrow Tramways Company.

Before Mr. Justice Joyce, in the Chancery Division, on Tuesday, the matter of Richardson *v.* The Barrow-in-Furness Tramways Company, Limited, came up.

Mr. Hughes, K.C. (Mr. Willis Bund with him), for the plaintiff, said this was a debenture-holders' action, Richardson representing holders of first debentures to the amount of £12,500. There were second debentures of £2,500. A receiver and manager of the tramway company's undertaking was appointed in February, 1896, and he negotiated its sale to the British Electric Traction Company, who became the purchasers in 1899. The price paid was £22,750, and the receiver seemed to have thought that that sum would have been sufficient to pay both first and second debentures, which was not, in fact, the case. The British Electric Traction Company paid the purchase money into Court, and by order of the Court the principal money due to the first debenture-holders was paid out to them in April last. The financial position at the present moment was this:—There was a fund in Court of approximately £8,165. The receiver's account, which had not yet been passed, showed a balance due to him of £3,547, and £328 was due for wayleaves to the Furness Railway Company. Interest due on the first debentures until payment of the principal had not been paid, and that amounted approximately to £3,403. Deducting these sums, there remained a balance of the fund in Court of about £885. In these circumstances he applied that, after paying the receiver's remuneration, the money remaining should be first applied to payment of interest to the first debenture holders, and their costs.

Mr. Hamilton, K.C., for the second debenture holders, asked for his clients' costs, as the receiver and manager could not have sold the tramway without their assistance and consent.

Mr. Younger, K.C., on behalf of the company, claimed that they also were entitled to their costs out of the fund in Court.

Mr. Justice Joyce directed that the costs of the second debenture holders on the taking of the account and of the motion should be paid out of the fund, the company to have their costs, generally, before the payment of debenture interest.

Pirie *v.* The Electro-Chemical Company (1900).

In the Chancery Division on Friday, Mr. Justice Farwell heard a motion, brought on by Mr. Stewart Smith, in the action of Pirie against the Electro-Chemical Company (1900), of St. Helens. Counsel said that the motion was for the appointment of a receiver in the interests of the debenture holders. The company was incorporated in February of last year, with a nominal capital of £200,000 in £1 shares, and its object was to acquire certain works, and work a new electrolytic process. A sum of £40,000 had been subscribed on debentures, which were a charge on the whole of the assets of the company, except its foreign and colonial patents. The debentures had become due in consequence of a winding-up resolution having been passed a day or two ago, the confirmation meeting being summoned for the 21st inst. The undertaking had proved unprofitable, and the directors had closed the works and discharged all hands. They considered that the best course for all interested was to wind up the company, but to have certain plant and machinery running occasionally to keep it in proper condition for sale.

Mr. Topham, for the company, said he did not object to the application, and his Lordship thereupon made an order appointing Mr. Robert Shaw receiver and manager.

Isle of Man Tramways Company.

In the Manx Chancery Court last week, Mr. Farrant presented the petition of William Henderson Walker, liquidator of the Isle of Man Tramway Company, to have a statement of receipts and expenditure of the company from the date of his appointment, July 25th last, to December 30th, filed in Court. A witness deposed that the receipts for the period named amounted to £29,82[illegible], expenditure to £23,861, and the balance paid into Court was £5,95[illegible]. The accounts were passed.

CORRESPONDENCE.

The Tooting Bec Asylum Tenders.

We notice in your "Correspondence" of this week a reference to the tenders recently received by our clients, the Metropolitan Asylum Board, for wiring Tooting Bec Asylum to our specification.

It is to be regretted that our estimate for the work, which, in accordance with the usual custom, was attached to the list of tenders when the results were published by the Board, does not appear to have found its way into all the papers, although it is correctly given in the *Contract Journal* for this week. This estimate was £5,000, and as you will see from the list of tenders, there were, for wiring tenders, a large number of prices round and about this figure:—

	£	s.	d
R. Dawson & Co., Ltd., Stalybridge (accepted) ...	4,416	0	0
Barlow Bros. & Co., 237, Shaftesbury Avenue, W.C. ...	4,487	0	0
Hampton & Sons, Ltd., Pall Mall, East, S.W. ...	4,544	0	0
Lea & Warren, Glenroy Works, Kettering	4,625	0	0
National Electric Wiring Company, 83, Newington Butts	4,690	0	0
Fryer & Co., Sloane Square, S.W.	4,692	0	0
H. J. Godfrey, 188, High Road, Balham	4,713	0	0
Weston & Co., 58, Fenchurch Street, E.C.	5,460	0	0
Manley & Co., Ltd., 25, Victoria Street, S.W.... ...	5,624	0	0
Cook & Co., Lightcliffe, Yorks	5,800	0	0
T. Scott Anderson, Royal Insurance Buildings, Sheffield	6,000	0	0
Geipel & Lange, Parliament Mansions, S.W.	6,550	0	0
A. Fearnhead, 354, Caledonian Road, N.E.	6,591	8	7
Concentric and General Contract Co., 52, Queen Victoria Street, E.C.	7,015	0	0
Donnison, Berlyn, Sillem & Co., 116, Great Portland Street, W.	7,097	12	0
Lummis, Paterson & Co., 79, Percy Street, Newcastle-on-Tyne	8,000	0	0
Benham & Sons, Ltd., 50, Wigmore Street, W. ...	8,230	0	0
Cooper & Co., 703, Fulham Road, S.W.	8,235	10	0
T. H. Wathes, Belgrave Street, Leicester	10,637	12	7

On the whole the tendering is pretty close, the £10,000 and other figures of course being accounted for by the fact that when they received the specification, several firms found for various reasons the work was not in their line, and so put in a price to cover themselves and get back their deposit.

It is to be regretted that prices for wiring work vary so much as a rule, but this may possibly be explained by an incident that occurred with this very specification. The plans of the buildings were to be seen at the architect's offices in London, and one of the tenderers informed us the day before the tenders had to go in that he did not consider it worth while inspecting them, as he knew what asylum buildings were like, and as regards the length of the main cables from the engine house to the various blocks, he had done an asylum before, and he knew about what to allow. We may say that these cables formed a pretty big proportion of the contract.

Hancock & Dykes.

Cardiff Distribution.

I quite agree with the remarks made by your correspondent, "G. F. K.," in your issue of the 1st inst.

During my 20 years' experience in the electrical profession, not only have I seen instances "where young men and mere boys" have, through influence, been put into positions for which they were totally unfit, but in many cases, although willing enough on first being appointed to gain all the information possible from older and more experienced persons, who in some cases, through lack of influence, have been placed under them, after a short period of authority they have pooh-poohed! suggestions which have been made to

them as the result of years of practical experience, or have shelved them, in some instances, for a time, to eventually bring them forward as their own ideas. Especially have I noticed this in the case of central station distribution.

In your issue of November 30th, 1900, under the heading, "Precautions against Electric Shock," I commented on the matter of badly equipped sub-stations and distribution generally. I could point to several provincial stations where at least some of the sub-stations are a disgrace.

With reference to Mr. Appelbee's letter in your issue of 1st inst., he states: "The question of changing over to the low pressure direct current system has been under consideration a long time, and has checked the spending of capital freely on sub-stations, &c."

Surely Mr. Appelbee does not intend to advance this as a reason why, according to Mr. Ellis's report to his committee, he found many of the sub-stations to be in such a condition, as to be "veritable death traps," and the distribution generally in a shockingly bad state?

It is certainly not to the credit of the profession, that an engineer upon being appointed should feel it his duty to be compelled to speak in such terms of a portion of the plant placed under his control.

Upon referring to my back numbers of the Electrical Review, I find that the mains superintendent in August of last year, on appearing before the Cardiff Electricity Committee to explain the cause of his resignation, gave as one of his reasons, that upon examination of the sub-stations and distribution generally, after his appointment, he found it in a very bad state, and did not appear to be receiving the co-operation of other officials to improve it.

Mr. Appelbee appears to have denied the statements of the Mains' Superintendent, and I gather from his letter in your issue of February 1st, that he denies the statements of Mr. Ellis *re* the bad state of sub-stations and system of distribution generally.

Distribution.

[We have cut out from this letter certain passages which appeared to us to be somewhat objectionable.

We should like to remind our correspondents that Mr. Ellis spoke of "carelessness on the part of the outdoor department"; and in our note we pointed out that in our opinion the Electric Lighting Committee was directly responsible for the condition of the sub-stations, "seeing that it repeatedly refused to furnish its electrical engineer with a full measure of authority."—Eds. Elec. Rev.]

In the "Correspondence" column of your last issue, "G. F. K." takes exception to the way men are often pushed into important posts, but I think it is only right and just that a resident engineer should be permitted to choose his own staff, and naturally he would prefer men with whose work he was acquainted. Such a course will generally tend to the well-being of an undertaking, for an engineer who is responsible for the staff is hardly likely to appoint a "rotter"; at the same time, it is certainly hard on those junior engineers whose circle of friends is limited.

With regard to consulting engineers it is a different thing, and they should certainly have no voice in the appointment of a chief engineer; the latter might, with advantage to his employers, be an enemy rather than a friend to the former. The way some consulting engineers have lately pushed their own men into the position of resident engineers will eventually open a very wide door to corruption, and often deters many good men from applying for the positions. No doubt it causes keen competition for positions on the staff of the consulting engineer or makes a vacancy for a pupil at a high premium; but that is of no interest to the Electricity Committee, or whoever the employers may be; they are seeking the best man in the market for their money and seldom find him.

W. H.

February 4th, 1901.

Third Rail Electric Railways.

To one of the early workers in the electric railway field it appears strange that, at this comparatively late period in such practice, there should be wide diversity of opinion regarding the feasibility of protecting surface-conducting rails from casual contact. On the old Baltimore and Hampden electric railway, built and equipped by the writer in 1885, though the P.D. never exceeded 270, it was soon found necessary to protect the third rail from end to end, as the track occupied one side of a public road, and as this was probably the first commercial electric railroad in the U.S., it was not only politic but indispensable to avoid increasing the jealous distrust with which such enterprises were publicly regarded, hence the quickest and cheapest means were at once adopted by placing ordinary builders' 3 inches × 4 inches "scantling" on either side of the third rail, and raised above it some 2 inches by bevelled wooden supports at intervals of about 30 inches. Though it cannot be said that this added to the picturesqueness of the landscape, it certainly answered its purpose most effectually, for though the road was in constant use for four years thereafter, no further trouble was experienced. In this instance the danger to human life was insignificant in view of the low pressure employed, but it was quite sufficient to kill horses, as had been thrice proved before the guard was placed. In the little illustrated article (in *Cassier's Magazine*) which I send herewith are two or three photo-engravings taken along the road while being operated with the original equipment.

In the same article, figs. 5, 6, and 7 [which are reproduced below] show methods of perfectly protecting a surface rail, which were designed by the

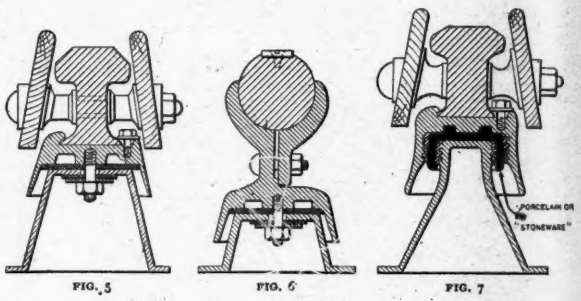


FIG. 5 FIG. 6 FIG. 7

writer some years since, and while reasonably presentable, are strong and inexpensive. A guard of this kind is now in use at Wansee, Germany, and others of almost exactly the same pattern will shortly be placed on two roads in the United States.

Regarding the question of safe and unsafe electrical pressure, it seems strange that such eminently important factors as personal resistance and contact area should be so persistently ignored by men whose duty it is to instruct linemen and other mechanics; and the evidence given at inquests by "experts" is frequently of a character to emphasise the unaccountable recklessness displayed by the average station attendant. *A propos* of this subject, I enclose pamphlet published by the Daft Electric Company, containing extract entitled "Danger," from a lecture delivered by the writer at Newburgh, N.Y., in February, 1886. There can be no question in the minds of experienced persons that fatal shock may be imparted to a healthy organism with less than 300 volts pressure, under favouring conditions of contact area, &c. This is, of course, no argument against the employment of high pressures, which are necessary from considerations of economy and development; but, on the other hand, a like consideration should be sternly eliminated in the matter of safeguards.

Leo. Daft.

Information Wanted.

I have a cable very lightly insulated, ·5 square inch in cross-section, to carry on posts and steel suspending wire. On the posts the cable will be carried by a mushroom oil insulator, the suspending wire by an ordinary block insulator. The wire for suspenders is No. 8 galvanised iron.

How far ought the suspenders to be spaced apart?

What if an insulator should be used between the cable and suspender, or between the suspender and the suspending wire?

Reader.

Can any reader recommend a good practical treatise on crane and lift motors?

Interested.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Jan. 6th, 1900.		Week ending Feb. 5th, 1901.	
Alexandria. Teleph. wire	Value £25	Adelaide ..	Value £1,900
Amsterdam	210	„ Teleg. wire	187
Bangkok	141	Alexandria	211
Batoum. Teleg. mat.	40	Amsterdam	110
Boca Teleg. mat.	176	Auckland	122
Bombay	83	Boca	978
„ Teleg. wire ..	200	Bombay	423
Brisbane	91	Brisbane	40
„ Teleph. appar. ..	79	Buenos Ayres	208
Buenos Ayres	2,514	„ Teleg. mat. ..	330
„ Teleg. mat. ..	586	Calcutta	354
„ Teleg. wire ..	416	Cape Town	141
Calcutta	1,282	Chinde	81
Cape Town	244	Colombo	200
„ Teleg. mat. ..	74	Copenhagen. Teleg. wire ..	173
„ Teleg. sundries ..	95	Demerara	55
Chinde. Teleg. mat.	368	Durban	438
Christiania. Teleg. wire ..	137	„ Teleg. apparatus ..	607
Colombo	1,022	East London	1,250
Copenhagen. Teleg. wire ..	186	Fremantle	18
Durban	201	Hamburg. Teleg. mat.	400
East London	48	Hobart	30
Flushing	84	Hong Kong	17
Gothenburg	37	Huelva	27
Halifax. Teleg. cable ..	708	Malta Teleg. mat.	111
Hamburg	571	Melbourne	607
„ Teleg. mat.	250	„ Teleg. mat.	494
Hong Kong	153	Newcastle	33
Malta	140	Ostend	180
Melbourne	351	Perth	92
Nagasaki. Teleg. cable ..	1,800	Port Elizabeth	217
Ostend	105	Rosario. Teleg. mat.	119
St. Petersburg. Teleg. wire ..	220	Santos. Teleg. mat.	887
Santos	80	Shanghai	159
Shanghai	101	Singapore	35
Singapore	108	Sydney	1,447
Sydney	655	„ Elec. detonators ..	149
Wellington	210	„ Teleg. mat.	247
„ Teleph. mat. ..	199	Syra. Teleg. cable	24,000
		Valparaiso	234
		Wellington	51
		Yokohama	75
		„ Teleg. cable ..	517
Total ..	£24,484	Total ..	£36,680

Foreign Goods Transhipped.

Brisbane. Teleph. appar.	Value £160	Bombay, Elec. machinery	Value £129
Buenos Ayres. Electric light fittings	120	Perth. Elec. apparatus	35
		Sydney. Teleph. apparatus ..	73
Total ..	£280	Total ..	£237

Bankruptcy Proceedings.—Under the failure of Alec Gavan Inrig, lately trading as the Globe Electrical Company at 46, White Post Lane, Victoria Park, an application was made last week to Mr. Registrar Hope, at the London Bankruptcy Court, for an order of discharge. The Official Receiver reported that the bankrupt failed in June, 1899, with ranking liabilities £4,461 12s. 5d., and assets that had realised £201 6s. 3d. A dividend of 9½d. in the £ had been paid on proofs admitted for £2,981 7s. 1d. The bankrupt came to London from Antwerp in September, 1895, with £1,000, and commenced business on his own account. In February, 1896, he was joined by a partner who brought in a small amount of capital on condition that the business should be converted into a limited company. That arrangement was carried through shortly afterwards, Inrig & Chester, Limited, being registered with a nominal capital of £2,000. As vendor to the company, the bankrupt received £500 in fully-paid shares, and continued to act as managing director, at a salary of £5 weekly, until the company went into liquidation in November, 1896. Under the liquidation the business was purchased by the petitioning creditors, who, early in 1897, entered into a hire-purchase agreement with the bankrupt for the resale of the business to him. That arrangement apparently was not carried out, and the business was continued under the bankrupt's management at a weekly salary of £5, subsequently reduced to £3, until November, 1898, when the petitioning creditors, who had been making advances for the purposes of the business, declined to find any more money, and the business was subsequently carried on by the bankrupt himself down to the date of the receiving order. The failure was attributed to the course adopted by the petitioning creditors in respect of the business, and whom, as the bankrupt alleged, he regarded as responsible for the debts. Proofs had, however, been admitted by the trustee to the extent of £2,981, and the bankrupt had admitted that the business was carried on by him on his own account from November, 1898. The offences alleged by the Official Receiver were—(1) insufficiency of assets to pay 10s. in the £ to the unsecured creditors; and (2) imperfect book-keeping. The bankrupt, in making the application, contended that the business was not his property. His Honour suspended the discharge for two years.

Application for discharge made by C. B. Harness, late managing director of the Medical Electrical Institute, is to be heard at Wandsworth on February 18th.

Notice of dividend is given in the *London Gazette*:—A. W. Hirst, electrical engineer, West Croydon.—First dividend of 3s. 6d., payable February 15th.

A receiving order has been made on a creditor's petition against T. A. Flather, electrical engineer, Park Electrical Works, Speedwell Street, Leeds.

T. A. Flather, electrical engineer, Leeds. — First meeting, February 13th, and public examination February 26th—both at Leeds.

A first and final dividend is to be declared in the matter of the Phaeton Electrical Company, Limited, and claims should be sent to W. J. Ogden, liquidator, 6A, Austin Friars, E.C., by February 20th.

Dissolutions. — Messrs. A. Maund and W. D. Seed (Maund & Seed, electrical and mechanical engineers, of Southport and Wigan) have dissolved partnership. Mr. Maund will attend to debts, and will continue the business.

Books Received.—"Science Abstracts" for January, 1901. W. R. Cooper, Editor. "Index to Science Abstracts," Vol. III. (1900). London: E. and F. N. Spon. 2s. each.

"County Council Scholarships Return, 1900." London: Eyre and Spottiswoode. 1s. 4d.

"Mésures Electriques." By E. Gérard. Paris: Gauthier-Villars. Second edition, 1901. 12 fr.

"Annual Report of the Chief of the (U.S.) Bureau of Steam Engineering, 1900." Washington: Government Printing Office.

"Fire Tests with Doors," Nos. 54 and 59. London: The British Fire Prevention Committee. 2s. 6d. each net.

Catalogues and Lists.—The Westinghouse Companies' list, No. 1,038, is devoted to a description of the general design and construction of their No. 49 tramway electric motor, which was placed on the market in 1897.

Messrs. Everett, Edgcumbe & Co., of Charterhouse Square, E.C., and Westminster, have issued a new list of their "E.E." electrical measuring instruments, including electro-magnetic and moving coil ammeters and voltmeters.

The Bethlehem Steel Company, of South Bethlehem, Pennsylvania, recently sent us several pamphlets describing its high-speed cutting tools treated by the "Taylor-White" process; also its nickel steel forgings for marine and stationary engines, armour plate, &c.

A new catalogue has been issued by the Wheeler Condensing and Engineering Company, Limited, in which they detail some of their latest specialities, and give notes of a few of the various cooling tower plants erected by them at electric light stations. The Wheeler condensers, feed waterheaters, cooling towers, and so on, are shown by numerous excellently executed illustrations, including many sectional sketches showing the general construction in great clearness. Central station engineers will be interested in this list.

The Jackson-Mensing arc lamps for direct and alternating current circuits form the subject of a neat little pocket list just issued by Messrs. P. R. Jackson & Co., Limited, of Manchester. Line resistances, choking coils, and various sundries are particularised.

Messrs. Joseph Kaye & Sons, Limited, of Leeds, send us a circular of their well-known patent seamless copper or brass oil cans.

The Goheen Manufacturing Company, of Canton, Ohio, sends us a pamphlet showing views of a few structures upon which their carbonising coating has been used. This coating is not a paint, it is a chemical combination of materials so combined as to give the structures to which it is applied lasting protection at a low cost.

Mr. Wilson Hartnell, of Leeds, has issued a new edition of his catalogue describing various types of electrical and general engineering plants, continuous current dynamos, and motors for various voltages are fully specified. Direct coupled plants, including gas engine sets, switches and switchboards, three-throw pumps, boosters and automatic expansion regulators appear. The photographic illustrations are very attractively prepared, in fact, the get up of the entire list is very good.

Messrs. R. W. Blackwell & Co., Limited, have just brought out a well-arranged illustrated catalogue (No. E 51) of the "Universal" D.C. electric motors of ¼ to 75 H.P., open or enclosed, and with shunt series or compound windings. Sundry insulating materials, carbons, gauze brushes, and fan motors are included in this list.

Messrs. Gilbert Gilkes & Co., Limited, of Kendal, have recently published a pamphlet got up in excellent style in which they illustrate in a very fine manner a number of the electrical installations which have been carried out by them. Special attention has been paid by this firm to the utilisation of waste water-power for small private installations, but the descriptions in this catalogue are not confined to water-power plants. The installations described include gas-driven plant at Underley Hall, steam-driven plants at Ackworth School, Abinger Hall, and a number of other places, and water-power installations at Ingleton, Cowley Manor, Syde House, Cheltenham, Newbiggin Hall, &c. The *brochure* will be found acceptable to all who take an interest in private installation work.

Electric Fan Tests.—Some tests have been carried out by Dr. Hele-Shaw, F.R.S., and Mr. Alfred Hay, B.Sc., with two of Messrs. John Gibbs & Son's electric fans, one of which was a 24-inch fan, while the other, driven by a watertight completely enclosed motor, was a 15-inch fan. The 24-inch fan when supplied at 100 volts took 3·05 amperes and ran at 655 revolutions per minute, delivering 5,100 cubic feet of air per minute. The temperature rise of the motor after 3½ hours run was found to amount to only 23° F. The same fan when fitted with a conical discharge pipe tapered from 24 inches to 12 inches, was found to take 3·2 amperes at a potential

difference of 105 volts, discharging 1,360 cubic feet per minute. The pressure in the discharge pipe was found to exceed that of the atmosphere by an amount corresponding to a column of water ¾-inch high. The smaller fan was also driven by a totally enclosed waterproof electric motor. When supplied at 110 volts, the fan ran at 695 revolutions per minute, taking 1 ampere and giving a discharge of 1,160 cubic feet per minute. The temperature rise after three hours' run was found to be 50° F. These results are considered to be highly satisfactory, while the mechanical construction of the fans is reported to be substantial and the workmanship good.

Export Shippers' Directory.—Messrs. Dean & Son, Limited, have issued the 1901 edition of their valuable guide to the "Export Merchant Shippers of Great Britain and Ireland" (17s. 6d.). The trading ports and classes of goods shipped are stated. The London itinerary issued as a companion to the book, but smaller and more pocketable, is doubtless of some service to commercial men calling on London exporters. It has been exhaustively revised. The arrangement of the entire volume remains unaltered, the present form having been found most convenient for ready reference; but as a proof of continued progress it has been augmented by 64 pages, care having been taken to make a judicious selection of the names of the additional firms to render it a thoroughly representative and useful list of responsible merchants, manufacturers and shippers. Owing to the increased demand it has been found necessary to double the 1901 edition.

For Sale.—The Aberdeen Electric Lighting Committee wants offers for two 23-kw. direct coupled continuous current Willans-Elwell-Parker sets.

The G.E.R. Company invites offers for the purchase of certain steam and hand-power cranes, &c., and for the present electric lighting installation at their Parkeston Quay. See our advertisement pages for details.

The Blackburn Corporation wants offers for two Willans-Siemens 45-kw. continuous current direct-driven sets. Particulars are given among our advertisements to-day.

Glasgow Exhibition.—In addition to loaning some machinery at the Exhibition, we understand that the Edison and Swan Company are supplying lamps free to the Exhibition authorities for lighting the Machinery Section and the Grand Avenue.

Jones Mechanical Stokers.—We are informed that these stokers are manufactured in this country, at Bedford, by the American Blower Company, of 70, Gracechurch Street, E.C., who also control their sale for the whole of Europe.

London County Council.—The Council at the meeting on Tuesday resolved to lend £830 to the St. Pancras Borough Council for the electric lighting of the public buildings, £17,229 to the Hampstead Council for electric lighting purposes, and £24,145 to the Fulham Council for a refuse destructor and street lighting works

Subways for Pipes and Conductors.—Mr. Parker moved that it should be referred to the General Purposes Committee to consider the best manner of bringing before the Borough Councils the imperative necessity of making subways under at least all the leading thoroughfares of the metropolis to contain all the gas and water pipes and telephone and telegraph wires; and, if necessary, to summon a conference to formulate some comprehensive scheme for remedying the ever-increasing inconvenience to pedestrian, omnibus and mercantile traffic caused by the constant disturbance of the footpaths and carriageways for the purpose of inserting or removing the pipes and wires in question. Mr. Baker, who seconded the motion, suggested that by the construction of such subways, the Council could have shallow tramways built, in addition to the provision of accommodation for pipes and conductors, which alone would earn the cost of the improvement. The motion was adopted.

New Tramways.—The Council decided, on the motion of Mr. Johnson, to refer to the Highways Committee to consider the desirability of obtaining Parliamentary powers for the construction of a double line of tramways on the new northern approach to the Tower Bridge, to join the Council's lines now worked by the North Metropolitan Tramways Company.

Mr. Baker had intended to move that the Highways Committee should be instructed to report whether the Council could not at once proceed to lay a double line of conduit electric tramway in Rosebery Avenue, the current to be obtained from one of the companies in the neighbourhood. The proposer, however, obtained permission to withdraw the motion, as the question was being dealt with by the Highways Committee.

It was decided to adopt a motion by Mr. Westacott, instructing the Highways Committee to report as to the powers of the Council to convert to electric traction the tramways leased to the North Metropolitan Tramways Company and the amount of the estimated expenditure in connection with the work.

New Issue.—Mr. B. T. Batsford, of Holborn Viaduct, announces a second issue of Mr. Edwin O. Sachs's monumental work, "Modern Opera Houses and Theatres," which will be published in the Spring.

New Supply House.—The Imperial Electric Supplies, Limited, have opened premises at 76, Charing Cross Road, and announce that they are the British agents for the Lorain Steel Company's tramway motors, controllers, and equipments.

Partnership.—We are informed that Mr. T. H. Roberts-Wray has resigned his position as general manager to the Renewable Electric Lamp Company in order to go into partnership with Mr. Alfred Baxter, the late London representative of the British Electric Works Company, Limited, and to carry on business as electrical engineers and suppliers of universal electric supply machinery.

The Prosecution of the Blackheath Company.—Before Mr. Kennedy at the Greenwich Police Court on Thursday last week, the hearing was continued of the summonses issued against the Blackheath and Greenwich District Electric Light Company, Limited, at the instance of Mr. Joseph Owner, H.M. Inspector of Factories, alleging that at their works at River Terrace, East Greenwich, a person named Arthur Robinson was killed on October 22nd in consequence of their having neglected to securely fence certain machinery upon the premises, and further, that they had failed to register an accident within one week of its occurrence, and that certain machinery dangerous to persons employed on the premises was not securely fenced. Mr. Gray was counsel for the Home Office. Mr. Blanchard Wontner, for the defence, contended that it would be idle to ask for a conviction, as the very work upon which Robinson was engaged when he met his death was the fixing of a hand-rail, or a fence, in other words, in front of the switchboard, such as, according to the prosecution, was insisted upon by the Factory Acts. The magistrate could hardly convict the defendants for endeavouring to comply with the law. He, however, called Mr. John A. Constable, the company's resident engineer, who said that the switches in the station were placed upon a gallery 1¼ feet from the floor, to which access was gained by a staircase. After a fatal accident to a shift engineer, named Harbord, in March, india-rubber mats were placed upon the floor of the gallery, and the handles of the switches were raised to a height of 5 feet 9 inches from the ground. The company were taking advice with regard to the best model for improved switchboards, either caged or underneath the ground, one of which was to be adopted, but while this matter was being considered by Sir Frederick Bramwell's firm, it was thought wise to provide additional protection by a handrail in front of the switches, and the floor of the gallery was widened. It was while putting up the handrail that Robinson met with his death. He, and the others working with him, had been warned not, on any account, to touch the switchboards, it having been the intention that the company's own employés should fix the handrail to the switchboards, which was the only dangerous part of the work, on a Sunday morning, when the current could be switched off. A man was set to see that they did not meddle with the switchboards, but in his temporary absence they set to work taking out some bolts, with the result that Robinson was killed. Since the accident, pending the putting in of improved switchboards, vertical guards had been placed over the switches. The men whose business it was to work the switches had to wear gloves; and were only allowed to use one hand. Judgment was given yesterday, a fine of £10 under Sec. 5 of the Factory Act, £20 under Sec. 82, and 20s. on the first summons, with costs, being imposed.

Radiators.—A new type of glow lamp radiator is being introduced by the General Electric Company, Limited, as shown by the accompanying illustration. This radiator is intended to be of higher quality and better appearance than such apparatus have

generally been hitherto; we have examined one of them, and we must agree that the contention is fully borne out. The type illustrated has four frosted lamps, consuming 250—300 watts each; these are controlled by two switches, so that two or four lamps may be

used as desired. The radiator may be finished in a variety of styles to suit the taste of purchasers; they may be enamelled in colours, in which case they are washable. The radiator is called the "Apollo" type, and is, we understand, now ready for supply.

Trade Announcements.—Messrs. Edwards & Armstrong, of Bristol and Cardiff, have opened a branch at Union Chambers, Union Street, Swansea, and have already carried out several contracts for installations in the town, including one of 1,100 lamps at the "New Empire Palace."

Water Softening Plants.—Messrs. Mather & Platt, Limited, have received orders for the supply of water softening plants from the Metropolitan Electric Supply Company, plant to deal with 240,000 gallons per day of 24 hours; Hayling Water Company, plant to deal with 120,000 gallons per day of 24 hours; and Messrs. G. B. Kent & Son, plant to deal with 14,400 gallons per day of 24 hours, fortheir new works at Hemel Hempstead.

ELECTRIC LIGHT AND POWER NOTES.

Abersychan.—The U.D.C. has decided to apply for a prov. order for electricity supply.

Arbroath.—The E.L. Committee of the Gas Corporation has agreed to recommend that the electric lighting of the burgh should be carried out by the Corporation.

Bombay Train Lighting.—Mr. A. A. Crawford, of the Bombay Electric Company, has secured a contract to light the carriages of the R.M. Railway with electricity. The system has, says the *Madras Times*, been thoroughly tested and approved of by the authorities of that line.

Chelmsford.—The street lighting contract with the Electric Supply Company is to be renewed for five years at the rate of £25 5s. per arc lamp, instead of £22 10s., and £3 3s. per incandescent lamp, instead of £2 6s. 10d.

Chorley.—Mr. Ducat held an inquiry last week relative to the sanction of the L.G.B. to the borrowing of £23,000 for purposes of electric lighting, and £8,000 for a refuse destructor.

Cleveland and South Durham Electric Power Scheme.—A conference of local authorities interested in this scheme was held at Stockton last week. It was decided to invite representatives of the company to discuss the subject with the Corporations concerned at a future date.

Derbyshire and Notts Electric Power Scheme.—The Worksop U.D.C. has resolved to approach the promoters of the Bill with the object of inducing them to expunge the Worksop district from their proposals; if not, the Council will consider as to opposing the Bill.

The Belper U.D.C. has decided to oppose the Bill.

Dudley.—The T.C. intends to ask the L.G.B. to reconsider its decision not to sanction a loan for "free" wiring, and will send a deputation to the Board to that end. The electricity supply has now been inaugurated satisfactorily.

East Ham.—The Council has authorised cable extensions to cost £5,540.

France.—The question of lighting the commune of Bouzy by electricity is at present under consideration. The necessary current would be furnished by the generators of Messrs. Amelin, frères, of Tours-sur-Marne, who would enlarge their power station for the purpose.

The authorities of Thilleux, in the canton of Mortier-en-Der, Haute Marne, France, have decided on lighting the town by electricity. The motive power will be supplied by a water-course in the vicinity.

The Municipal Council of Sèvres had under consideration at its last meeting the question of lighting the town by electricity. A committee was appointed to study a project for the improved lighting of the town.

Irvine.—The T.C. has appointed Mr. Bryson, of Leith, consulting electrical engineer.

Italy.—The engineer Giacinto Motta, of Milan, has presented a project and application for concession for the utilisation of the waters of the Poglia di Valsaviore (Valcomonica) after its conflux with the Poja di Val di Brate and at a point 776 metres above the level of the sea. The volume of water would be 1,000 litres per second, of which, however, two-fifths would be furnished by Lake Arnor in time of dryness. The object of the engineer is to utilise the fall of water for the development of electric energy, estimated at 5,017 H.P., for motive-power, traction, and lighting purposes. The cost of the necessary works is estimated at 724,000 lire (£28,960).

King's Lynn.—It is the easiest possible thing in the world to oppose a new scheme, whether there is reasonable ground for doing so or not. We can quite understand one who has innate regard for the prosperity of gas interests deciding to oppose electric lighting. Of course a gas shareholder does not for an instant oppose electricity supply because it is likely to affect his personal interests, oh! dear no! He must necessarily be able to produce other reasons upon which to make it appear that his opposition is based. We have sometimes heard of gas-shareholder-councillors who have opposed electric lighting projects, and have actually voted against them, in spite of the illegality of such procedure, but, of course, no one would for a moment suggest that the public interests were being subjugated to their own personal and private concerns. At King's Lynn the Town Council, about 18 months ago, started an electricity supply undertaking, in connection with which electric street lighting was a very strong feature. After a momentous fight with the gas interests, gas was gradually displaced from the public lighting, and incandescent electrics and a few arcs took their place, with, as we ourselves thought at the time of our visit, a very satisfactory result. Anyone who knows anything about street lighting is aware of the fact that it is not professed that the substitution of electricity for gas is going to result in a lower public lighting bill, but he is also equally well aware that electric lighting affords a vast improvement—a benefit which the public, as a rule, is not slow to appreciate. The struggles with the gas company, which started there before the birth of electric lighting, are not yet at an end. Our readers are fully acquainted with the difficult task which has fallen to the lot of Mr. Pilling, the borough electrical engineer, in connection with the adoption of steam-driven plant in place of gas producers and gas engines, and he has deserved sympathetic support instead of querulous criticism. But the fact that opposition had been set on foot seems to be sufficient to justify some minds in continuing it. We find a letter in one of the local papers from a correspondent who does his level best to pick holes in the electricity undertaking. He has made an examination of the borough accounts, and tries to persuade his readers that for each unit that the shopkeepers are paying 5½d. for the cost is 1s. He talks of electric lighting as a fad on the part of "a few of our eccentric inhabitants," sometimes mistakes hansom cab lamps for the electrics (!) and the basis of his objections seems to us to be as much an ardent advocacy of incandescent gas as anything else. When *he* looks at the incandescent gas lamps at the East Anglian Hotel they outshine the arc lamps at the railway station. He wants to see electric incandescents in the streets replaced by gas incandescents; to see the charge to private consumers the actual cost of the current supplied. He does not want the general public to be any longer asked to contribute towards the lighting of a few shops in the High Street. The epistle is that of Mr. Thomas Brown, who is a shareholder in the Gas Company, and it is so clothed with hostile feeling that he asks to be pardoned for "showing very considerable irritation and temper." The general tone of his remarks is such that we cannot spare space to analyse the other points and figures which he tries to drive home to the local mind. The editor of the local paper in which the remarks appear is not to be carried away by Mr. Brown's earnest appeal, but adheres most strongly to his support of "Lynn's own (and good) electric light in contradistinction to gas supplied by a company with profit to make." Mr. Pilling and his Electric Lighting Committee have nothing to fear.

Llandudno.—Colonel C. H. Luard, inspector of the L.G.B., last week held an inquiry as to an application by the Council for power to borrow £1,500 for purposes of electric lighting. Mr. A. H. Preece, consulting electrical engineer, with Mr. C. H. Morton, resident engineer, explained the object of the loan.

Liverpool.—The Electric Power and Lighting Committee proposes that the price to be charged for electrical energy supplied to the tramways department for the year 1901 be 1·2d. per unit, and that the minimum rate for electrical energy supplied to ordinary consumers for power and heating be 1½d. per unit as from the end of the present quarter. The accounts for 1900 show a balance of £3,496 10s. 11d.; the committee has ordered this to be transferred to the reserve fund (renewal account). The committee also desires that the Council shall obtain the sanction of the Board of Trade to the borrowing of £300,000 for electric power purposes.

London.—Common Council.—The Building Act Committee lately recommended that the Council approve of the plans submitted with the application on behalf of the Charing Cross and City Electric Company, Limited, for the construction of a distributing station on a site at the rear of 82 to 84, Fenchurch Street, City, and that the Council authorise the erection of such distributing station, subject to the usual conditions. This report was adopted.

Islington.—The Electricity Committee of the Borough Council recommends that, at the expiration of the present quarter, the price for electrical energy during the hours of daylight be reduced from 3½d. to 2d. per unit.

Lyndhurst.—Mr. Wharton, engineer, on behalf of the promoters of a light railway and electric lighting scheme, has been before the Council and secured its approval of the scheme.

Motherwell.—The municipal electricity supply was inaugurated on Friday last.

Newark.—The D.C. has decided to adopt one of the two electricity supply schemes submitted by Mr. Vesey Brown, and to apply to the L.G.B. for leave to borrow £30,000.

Portsmouth.—At a meeting of the E.L. Committee last week it was decided to recommend the Council to borrow £24,478 for electric light works. Of this sum £10,895 has been already spent on 400 house connections during the year, and other work sanctioned by the Council; £4,322 is required for feeders. The remaining £16,717 is required for a new boiler house and coal bunkers, but for the present only £11,042 of this sum is to be spent.

North Metropolitan District (East Middlesex).—The reports of the engineers, Mr. W. C. C. Hawtayne and Mr. R. Hammond, to the Joint-committee of the Councils of Edmonton, Enfield, Southgate, Tottenham, and Wood Green, on the proposed scheme of electricity supply, state that an excellent site for the generating station is available at Edmonton. The probable demand is estimated at 100,000 8-C.P. lamps for private lighting, and 500 arc lamps for public lighting. Plant of 500 KW. output is allotted for power purposes. The three-phase system of supply is recommended, with generation at high pressure and distribution from sub-stations. The capital expenditure is apportioned as follows:—

Generating station buildings, shaft, &c., coal and ash conveying plant, &c., and purchase of site	£89,000	0	0
Generating plant	94,740	0	0
Mains, high tension feeders, low tension distributors, transformers, and sub-stations	109 260	0	0
Public street lighting	25,000	0	0
House services and meters	40,000	0	0
Free wiring	25,000	0	0
Legal, expert, and engineering fees and contingencies	23,000	0	0
	£345,000	0	0

The total plant capacity is 4,000 KW., of which 1,000 KW. will be held in reserve. Losses in distribution are estimated at 600 KW., leaving 2,400 KW. to be distributed as follows:—Public lighting, 310 KW.; private lighting, 1,590 KW.; power along the canal, and generally, 500 KW. The revenue is estimated thus:—

PUBLIC LIGHTING.

842,400 units at 2d.	£7,020	0	0

PRIVATE DEMAND, 1,590 KW.

Say, private lighting 53,000 lamps all burning at one time (106 000 connected) requiring 1,590 KW.			
1,590 KW. for 400 hours at 7d. = 636,000 units at 7d.	£18,550	0	0
1,590 KW. for 600 hours at 2d. = 954,000 units at 2d.	7,950	0	0

ELECTRIC POWER.

700 KW. installed, with a maximum load of 500 KW.			
500 KW. with 25 per cent. load factor = 1,092,000 units at 2d.	£9,110	0	0

FREE WIRING.

10 per cent. on £25,000	£2,500	0	0

METER RENTALS.

4,250 at 6s.	£1,275	0	0
Total	£46,405	0	0

EXPENDITURE.

The total cost of producing the before-mentioned 3,524,400 units should not exceed 1·5d. per unit, including management expenses and ample allowance for maintenance and repairs on buildings, plant and mains, &c. The total annual expenditure will thus amount to	£22 027	0	0

SUMMARY.

Revenue (as above)	£46,405	0	0
Expenditure (as above)	£22,027	0	0
	£24,378	0	0
Interest and redemption at 5¼ per cent. on £345,000	£18,112	0	0
Margin to the good	£6,266	0	0

The sum of £400,000 is put down in the bill, leaving a margin for extensions. The repayment of capital is deferred for three years.

The adoption of the three-phase system, *en bloc*, for lighting and power distribution is a striking innovation for this country, and keen interest will be manifested in the results. According to the above report, Mr. Hawtayne had originally prepared a two-phase scheme, but was convinced by Mr. Hammond that the three-phase system was the more suitable.

A public meeting was held on Monday at Enfield, and a resolution was passed approving of the action of the D.C. in combining with the neighbouring councils for electricity supply.

The Bill promoted by the District Councils is meeting with severe opposition. On Tuesday evening a large meeting of ratepayers was addressed at Edmonton by Mr. Offor, a director of the opposing company, who endeavoured to show that it would be much better for the ratepayers to leave the electrical supply of the district in the hands of his company than to trust to the District Council. A resolution protesting against the Council's action was declared to have been carried, but the meeting closed in disorder.

Russia.—The Electric Power Company, of St. Petersburg, which was formed for the purpose of supplying to the petroleum and naphtha wells at Bakou the electric energy necessary for working them, has netted a profit of 133,678 roubles on the past year. The capital of the company is 4,000,000 roubles, of which a sum of 3,200,000 roubles is already subscribed. The central power station of the company was originally designed for the supply of 7,000 H.P., but the installations are not yet fully completed. The station is built on the Caspian Sea, on the outskirts of the town of Bjely-Goradok. The distance from it to the petroleum fields is about six miles. There are six intermediate stations.

St. Helens.—At a meeting of the Electric Supply and Tramways Committee the borough electrical engineer (Mr. J. S. Highfield) reported that the number of electric lamps connected up to December 31st last was 19,6?8, against 10,612 in the previous year; the number of units sold for lighting purposes during December was 25,830, against 15,246; the number of units sold for tramway purposes was 59,035, against 23,355; and the number of units sold for motors was 8,468, against 1,085. The town clerk reported that he had received the sanction of the Board of Trade to the borrowing of £2,540 for the construction of tramways, exclusive of electrical equipment, along Corporation Street and Parr Street.

Shannon Water-Power Bill.—This Bill came before Mr. Campion, one of the Examiners of the House of Commons, for proof of compliance with the Parliamentary Standing Orders relating to the introduction of private Bills in Parliament. There was no opposition, and the Bill will be reported for first reading in the usual course.

Yorkshire Power Scheme.—A conference took place at Guiseley last week between members of local authorities in the Wharfedale Union and the promoters of the scheme. At the outset Mr. A. G. Lupton, chairman of the company, offered to insert the following clause in the Bill:—"Nothing in this Act shall prejudice any application by any local authority for a provisional order under the principal Acts for power to supply energy within their districts." The area included in the scheme is 1,800 square miles, with a population of 2½ millions, and contains in all 158 local authorities. The scheme is entirely in the hands of probable users of electricity. The capital proposed is £2,000,000.

ELECTRIC TRACTION NOTES.

Baker Street and Waterloo Railway.—This company has purchased the site and buildings of the Indigent Blind Schools, situated in St. George's Circus, S.E., for its generating station.

Birkenhead.—The B. of T. inspection of the new electric tramway between Birkenhead and New Ferry, Cheshire, was made on Thursday last week by Lieut.-Col. P. G. Von Donop, R.E. The overhead electrical line work was inspected by Mr. Trotter. The inspection was understood to be satisfactory. On Monday morning the first car started on the regular service.

The Central London Railway Company.—At the London Sheriff's Court, Red Lion Square, W.C., on 30th ult., before Mr. Under-Sheriff Burchell and a jury, Dr. Purves, a consulting physician, of 20, Stratford Place, Oxford Street, W., claimed £4,200 against the Central London Railway Company in respect of certain injury to his residence, alleged to have been caused by the construction of the new line. Expert witnesses examined on behalf of the claimant, estimated the cost of repairs at £2,294, and the depreciation in the actual value of the house at £500. Dr. Purves had sublet the ground floor and upper portion, and it was estimated that he would suffer a total loss of rental of £479 10s. He also claimed £1,000 in respect of personal inconvenience. The jury awarded £1,500.

Another claim was also heard last week by Mr. J. W. Penfold, F.S.I., sitting as arbitrator at the Surveyors' Institution. The claim was for injury done to No. 2, Lancaster Gate, W., and the claimants were Lord Herschell and Mr. A. W. M. Baillie, acting as executors under the will of the late Mrs. Mary Cunliffe.

Mr. C. A. Cripps, K.C., who appeared for the claimants, said that in consequence, it was believed, of the construction of the Central London Railway serious cracks began to appear at 2, Lancaster Gate, and there were indications that a serious subsidence was taking place. Owing to these disturbances the tenant, Mrs. Hawkins, left, and the house now remained unoccupied. The owners claimed damages to the amount of £1,000.

Mr. E. R. Robson, F.R.I.B.A., said he had inspected the house on May 17th, 1899, and found a number of cracks in the walls and ceilings. They seemed to him to be caused by a general disturbance of the foundations, due, he should think, to the construction of the railway.

Other evidence to the same effect having been put in,

Mr. Freeman, for the defence, said this was the first practical claim for damage brought against the company, and they were prepared to submit a large body of evidence to back up the defence. It was impossible from an engineering point of view that the damage could have been caused by the construction of the railway, which was 64 feet below the surface of the road. The house, which was 40 years old, had been built on the remains of a waterbrook, and there still remained a large deposit of mud, with an unstable substratum. Moreover, the bursting of a water-main in 1897 had undermined the foundations, and it was quite possible that this was the cause of the damage. The hearing was adjourned provisionally until February 8th.

The Committee appointed by the Board of Trade to inquire into the question of vibration in the working of the Central London Railway has made an exhaustive examination of the works at Shepherd's Bush. Mr. Mallock, the expert appointed by the Committee, has also been busy, and considerable progress has been made with the observations and experiments necessary for the taking of records.

Crewe.—A Light Railways Commissioners' inquiry was held on 30th ult. into an application by the T.C. for an Order to construct light railways within the borough. The evidence showed that it was proposed to borrow £100,000 for the construction of about eight miles of railway. The London and North-Western Railway Company said that the scheme was unnecessary and the expense unjustifiable. Allowing that 20,000 persons used the tramways every week, there would be a loss of nearly £10,000 a year. The railway company paid 30 per cent. of the rates of the borough; this loss would fall heavily upon them, and they protested strongly. The Cheshire County Council's opposition was as to the inadequate width of the roads. The Commissioners reserved their decision.

Darlington.—The General Purposes Committee, after considering the report of Messrs. Kennedy and Jenkin, consulting engineers, has decided to recommend the purchase of the present horse tramway system, with a view to the adoption of electric traction and its management by the Corporation. The Imperial Tramways Company are to be asked to sell the present tramways, the purchase to include also the Order of the Light Railway Commissioners obtained by the Tramway Company.

Darwen.—The T.C. has decided to proceed with the construction of a branch tramway to Hoddesden at a cost of £13,000.

East Ham.—The B. of T. have sanctioned a loan of £42,220 for tramway extension.

Electric Tramway Accidents in Germany.—It is stated in the *Financial Times* that the numerous accidents to persons which have taken place in Germany since the extension of electric tramways in that country have induced the authorities to make investigations, with a view to the prevention of such occurrences in the future, by the introduction of improved safety appliances or regulations governing the operation of the cars. In Berlin a preliminary inquiry is now being conducted by the Berlin Railway Administration and the Police President, and on its conclusion the Minister for the Interior and the Minister for Public Works, in conjunction with the street railway companies, will deliberate upon the results, and suggest remedies. The question has also been raised in, among other towns, Wiesbaden, Hanover, and Hamburg. In the latter city a Commission has been sitting for two years to consider the subject, and its report, which has just been issued, scarcely advances the object aimed at in any way. The Commission has made experiments with all existing appliances, and has come to the conclusion that none fulfil the desired object. The only proposal made for minimising the accidents is to reduce the number of electric cars in the main thoroughfares, and to request the public to exercise greater caution. It is, however, expected that the official inquiry now being made in Berlin will lead to more satisfactory results than are contained in the Hamburg report, which relates to investigations extending over so long a period as two years.

Electric Tramway Bills.—The Examiners of Private Bills of the House of Commons had an interesting point discussed before them last Friday afternoon. The following tramway Bills were in the list for the examination of Standing Order proofs:—City of Birmingham Tramways; West Cumberland Electric Tramways; the Bradford Corporation Improvements (including a tramway scheme); South Lancashire Tramways; Bexley Tramways; London County Council (tramways and street widenings); Scarborough Electric Tramways; Chester Corporation Tramways; Tyneside Tramways and Tramroads; and Wigan Corporation Tramways. Mr. Campion and Mr. Jeune, the examiners, were both present.

Mr. Campion, addressing the Parliamentary agents, several of whom were in the room, said, in cases where it was proposed to electrify existing tramways, there was ground for supposing that a disturbance of streets would be necessary, and the point had arisen whether this fact would not bring the Bills within Standing Order No. 10, providing for the notice necessary in respect of proposed new tramways, &c. He understood that the agents maintained that the Order did not apply in the case of an existing tramway on which it was proposed to substitute electricity for horse traction. They would consider the Birmingham Tramways Bill first, and take that as a test case. If the agents were able to satisfy them that the Order did not apply, well and good, but if not, that would dispose of the Bills.

The Parliamentary agent for the City of Birmingham Tramways Bill, Mr. John Kennedy, then put the views of the agents on the point. There was, he said, no doubt whatever in their minds, it being clear to them that Standing Order No. 10 did not apply. In the Birmingham case the tramways were so extensive that the additional expense to the promoters if Standing Order No. 10 did apply would be some £3,000, £4,000, or even £5,000, as it would mean posting notices in the streets and the preparation of a number of plans, &c. This he maintained was unnecessary where tramways already existed.

Mr. Pritt, of the firm of Sherwood & Co., Parliamentary agents, having been invited by Mr. Campion to give his view, said it was the same as that given by Mr. Kennedy; and Mr. Cripps, Parliamentary agent to the London County Council, also addressed the examiners.

Mr. Campion, in announcing the decision, said the examiners were satisfied in the matter. When the clause of the Standing Order was drafted electric traction was not contemplated, and that was the way the difficulty had arisen. If anything further ought to be done for the protection of the public or the frontagers, it should by done by the amendment of the Standing Order.

By this decision the examiners find that the Standing Order does not apply to such cases as those under consideration.

Hyde.—Colonel Von Donop held a L.G.B. inquiry into the application of the Bredbury and Romiley Urban Council for power to borrow £25,000 to construct a tramway from Stockport to Hyde. The line will be constructed and leased to the Stockport Corporation for 21 years at a rental.

The Hyde Town Council has passed a resolution that a joint board be constituted and incorporated, consisting of representatives of the Corporations of Hyde, Stalybridge, Dukinfield, and Mossley, and authorising the board to construct and work tramways, and to supply electrical energy in the four boroughs.

Leicester.—On Tuesday the T.C. considered the report which recommended that steps should be taken to purchase the tramways undertaking, and to work it by electricity; further, that Parliamentary powers should be sought to reconstruct and equip extensions of the existing lines and a number of new lines in the borough; also to construct an electric power station, depôts, and buildings, and to acquire land necessary for the work. The committee advised the adoption of the overhead system, and that the central power station should be on the Belgrade Road, where the heat from a refuse destructor could be used in the generating of power. Car sheds should be erected close by, and it is believed this station would prove sufficient to supply electric current for the whole of the present system, and also for much larger extensions than are at present proposed. District car sheds will be erected, and the buildings acquired from the Tramway Company adapted for electric traction purposes so far as deemed advisable. The Committee further recommended that the services of an expert of experience in electric traction should be engaged to advise and assist in the capacity of consulting engineer in the preparation of the scheme. Councillor Flint proposed the adoption of the first of five resolutions comprehending the suggestions in the report, which was seconded by Councillor T. Smith. Councillor Hudson criticised some of the details of the report, urging that the heat from other destructors should be utilised. Eventually a resolution was adopted that steps should be taken to purchase the tramways undertaking from the company to be worked by the Corporation under their statutory powers, and that the system should be equipped for electric traction. The Mayor criticised the system proposed, and urged that the power station should be at the existing electric lighting works. The remainder of the report was referred back to the committee for them to obtain expert advice as to their proposals.

Liverpool Overhead Railway.—This railway company run a line of electric tramways from Seaforth Station to Great Crosby, the trams starting from the company's station yard. To enable passengers to effect a change from the trains to the trams with comfort, the whole of the space has been roofed in, and as both the trains and trams are heated by electric heaters, the journey can now be made, in any weather, from Liverpool to Great Crosby in comfort. Another alteration that has been effected is the erection of an inclined elevator, which will convey passengers from the ground level to platform level without any effort. This is the second elevator of its kind that has been erected in this country, and the first one for railway purposes; the only other being at the Crystal Palace. The elevator is driven by an electric motor, and travels at the rate of 90 feet per minute, with a capacity of 3,000 passengers per hour. No doubt if the working of the inclined elevator is satisfactory at Seaforth, the directors will consider installing them at some of the other stations. This apparatus is now open to the public. The elevator has been built and fixed by Messrs. G. Aston & Sons, of London, under the supervision of Mr. Wainwright, the general manager to the company; the whole of the work being carried out to the designs and specification of the engineer to the company, Mr. S. B. Cottrell.

Manchester-Liverpool Express.—The Parliamentary Committee of the Liverpool Corporation has reversed its previous decision to oppose the Parliamentary Bill for constructing a mono-electric railway between Liverpool and Manchester. By the casting vote of the chairman, the previous resolution was rescinded, and it was decided to recommend the City Council to oppose certain clauses only.

Merthyr.—The B. of T. arbitrator (Mr. Sheldon) having prepared his award in the dispute between the Merthyr District Council and the Electric Traction Company, it has been taken up by the company, and is understood to be in their favour practically at all points. The costs will fall on the District Council. The company will now complete the gaps in the line at Pontmorlais, a section which was involved in the dispute.

Paisley.—In anticipation of the expiry of the tramway company's lease, the Corporation have decided to negotiate with the company for the sale of rolling stock, &c.

The Council will oppose Mr. Murphy's Tramways Bill. Messrs. Atherton have written notifying their intention to apply for powers.

Ploeshti (Roumania).—The adjudication for the concession of an electric tramway service in Ploeshti, Roumania, under consideration on January 23rd, not having given a satisfactory result, a second adjudication will be held shortly.

Portsmouth.—On Thursday last week at the Surveyors' Institute, Westminster, an inquiry was opened before Sir Frederick R. Bramwell as to the amount to be paid by the Corporation of Portsmouth for the undertaking of the Provincial Tramways Company.

Reddish.—Colonel von Donop has held a L.G.B. inquiry into the application of the U.D.C. for sanction to borrow £13,500 for the construction of tramways.

Sedgley and Wolverhampton.—It is stated that the British Electric Traction Company will have their line from Sedgley to the Fighting Cocks (Wolverhampton) electrically equipped by September next.

Liverpool.—The Tramways Committee of the Liverpool Council has instructed the town clerk to report what steps would be necessary to enable the Corporation to borrow £600,000 for the construction of tramways sanctioned by the provisional order.

Taunton.—The T.C. met on January 28th to consider a report from the E.L. Committee presenting forms of agreement with the British Electric Traction Company. The Committee presented two forms of agreement—one between the Taunton and West Somerset Electric Railways and Tramways Company, Limited, of the one part, and the Taunton Corporation of the other part. According to the first of these the Corporation agree to lay down plant to supply electrical energy for the trams within a reasonable time or to be subject to penalties; to lay down adequate spare machinery to ensure specified supply; and to do necessary excavations, &c., at the expense of the company, for laying and maintaining supply main. The company undertake to pay for a minimum yearly consumption of 60,000 units at 2d. per unit. By the second agreement the British Electric Traction Company guarantee to the Corporation the payment during seven years for the yearly minimum of 60,000 units at 2d. per unit, agreed to be taken by the tramways company; the payment during seven years for all excess of energy taken by the tramways company over and above the minimum; and the payment of all sums which might become payable within seven years under Section 41 of the Tramways Act, 1870, if the Corporation have (through default of the tramways company) to restore roads, owing to the ceasing of the working of the trams, but with power for the British Electric Traction Company to take over the working of the trams. Provision is also made for referring all questions to an arbitrator. These two agreements practically carry out the resolutions and arrangements of the Council; the committee therefore recommended the Council to approve of both of the agreements.

Watford.—A new tramway company, by the name of the Watford and District Tramways Company, is seeking Parliamentary powers for constructing tramways through Watford, Rickmansworth and Bushey. The length will be 8¾ miles, and the station will be erected in Bushey. The capital of the proposed company will be £125,000, of which £55,000 may be raised by the issue of preference shares.

West London.—The first trial trip was run in the small hours of Tuesday morning on the lines of the London United Tramways Company. The car, which contained Mr. J. Clifton Robinson, managing director of the company, and some members of the engineering staff, started from the generating station at Chiswick soon after midnight under the charge of Mr. J. Clifton Robinson, jun., and travelled over the Kew Bridge and Hammersmith section. In the course of the next few nights more cars will be taken out, and the number gradually increased until the line is loaded to its fullest capacity, cars running every two minutes, as will be the case under normal traffic conditions. On the data thus ascertained, the Kew authorities will be able to determine the amount of magnetic disturbance, if any, caused by the company's operations, and on the Kew report the Board of Trade will formulate the regulations to which the company must conform before the line can be opened for public traffic.

Wigan.—The engineer reported that the B. of T. inspector suggested that slipper brakes should be fixed on the electric cars instead of air brakes, and it was resolved that the offer of Messrs. Dick, Kerr & Co., Limited, to substitute a slipper brake and a rheostatic electric brake for the air brake provided for in the specification, be accepted.

Willenhall.—The British Electric Traction Company have given an undertaking to the Urban District Council to deposit plans and commence laying the lines in the Council's district during the next two months.

TELEGRAPH AND TELEPHONE NOTES.

Glasgow Telephones.—The location of three of the suburban exchanges has now been fixed, viz., Springburn, Strathburgs, and Govan. The premises have been leased for 25 years, with the option on the Corporation side of breaking the leases at the end of 10 years.

London Fire Stations.—The L.C.C. has resolved that public institutions, theatres and other buildings, of which many are already connected by telephone with fire stations at an annual cost of £5, shall in future be equipped with the apparatus designed by Commander Wells and Mr. A. C. Brown, for utilising fire-alarm posts for telephonic purposes. By this means, uniformity of pattern will be secured, and all the wires can be carried to one board in the fire station, with indicators to show the origin of calls. With a view to increasing the number of such connections, the annual charge is to be reduced to £2 2s., exclusive of the rent paid by the owner of the building to the Post Office for providing and maintaining the communication.

South African Cables.—The Eastern Telegraph Company notifies that a cable between Porthcurnow (Cornwall) and St. Vincent (Cape Verd Islands), *via* Madeira, was opened for traffic on Wednesday last week, thus completing the new direct cable route between Great Britain and South Africa.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
African—St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
South American—Pará-Maranham	March 1, 1900	
Cayenne-Pinheiro	Nov. 26, 1900	
Latakia-Cyprus	June 20, 1899	
Marseilles-Barcelona	Jan. 7, 1901	
Havre-Waterville	Jan. 19, 1901	Feb. 2, 1901
Malta-Tripoli	Jan. 24, 1901	Feb. 5, 1901
Singapor.-Banjoewangi	Jan. 25, 1901	Feb. 1, 1901
Fao-Bushire	Feb. 6, 1901	
Landlines:—		
South American—Communication with Carthagena and Baranquilla	Dec. 8, 1900	
Chinese—Tientsin-Pekin	June 11, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin and Taku *via* Helampo	June 18, 1900	
Shanghai-Amoy	Jan. 18, 1901	
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 26, 1900	

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—February 8th. The E.L. Committee wants tenders for surface condensers, air and circulating pumps. See "Official Notices" January 11th.

Aberdeen.—February 13th. The Tramways Committee wants tenders for electrical equipment of the Bathing Station route, comprising overhead material and underground cables. Poles provided by Corporation. See "Official Notices" January 18th.

Amsterdam (Holland).—April 1st. The Communal Council will on this date consider tenders for the supply and erection of all the motors necessary, and the installation of the electric lighting of the power station, switchboards, &c. Conditions from the Municipal Printing Office, 10 florins (8s. 4d.). Information from the manager of the office of Electricity, Achterburgwal, 213, Amsterdam.

Accrington.—February 28th. The Corporation wants tenders for two steam dynamos (185-kw.), condensing plant, balancer, battery, piping, arc lamps and pillars. See "Official Notices" to-day.

Ballinasloe.—February 9th. The Committee of Management of the Lunatic Asylum invite tenders for supplying and erecting the necessary plant and fittings for an installation in the New Hospital Block. For particulars apply to James Young, Clerk of Asylum.

Beckenham.—February 25th. The U.D.C. wants tenders for boilers, steam alternator, and combined engine, dynamo and motor set, pipework, batteries and switchboard for electricity works extensions. See "Official Notices" January 25th.

Bermondsey.—February 25th. The Borough Council wants tenders for switchboard and instruments, and battery. See "Official Notices" to-day.

Batley.—February 9th. The Corporation wants tenders for three high speed triple-expansion steam dynamos, one balancer, and one motor-generator. See "Official Notices" January 11th.

Bournemouth.—March 2nd. The T.C. invites tenders for 42 electric cars. See "Official Notices" January 11th.

Bournemouth.—March 4th. The T.C. wants tenders for three steam dynamos, and two steam-driven surface condensers. See "Official Notices" January 18th.

Brighton.—February 14th. The Council wants tenders for overhead trolley construction, and equipment of routes; also for feeder, distributing, test and telephone cables. See two "Official Notices" January 18th.

Brighton.—February 25th. The Council wants tenders for continuous current arc lamps, &c., for street lighting. See "Official Notices" to-day.

Clyde.—March 11th. The Trustees of the Clyde Navigation invite tenders for a 3-ton electric wharf crane for Prince's Dock. See "Official Notices" to-day.

(*Continued on page* 243.)

THE UTILISATION OF ELECTRICAL MACHINERY IN COAL MINING.

By W. C. MOUNTAIN.

The subject of this paper is one which covers so much ground that it is extremely difficult to deal with it in a short article, but the writer proposes to give his general views upon the necessity for the introduction of electrical machinery into coal mines, and the application of this machinery, in as brief a manner as possible.

Coal mines, particularly in the North of England and Scotland, and to some extent in the South of England also, have generally been in existence for a large number of years, and the machinery which is fixed and working is consequently of a somewhat antiquated type.

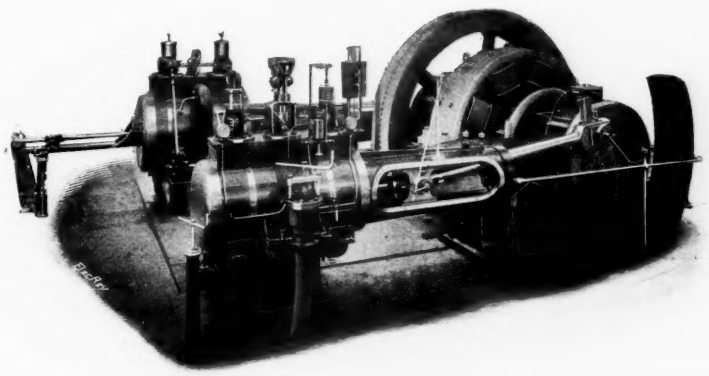


Fig. 1.

The boiler pressure in these cases is usually very low, often not more than 45 lbs. to 60 lbs. per square inch, and in some instances even less. It will therefore be readily seen that the adoption of electrical machinery, in connection with which much higher steam pressures can be utilised with more economical engines, means at the outset a considerable economy, if new boilers can be put down.

In dealing with any system of power transmission, the whole matter boils down to one of £ s. d., and it is necessary to prove to those who are considering the adoption of electrical machinery that they can not only obtain a considerable economy in working, but can also show a good return on capital expended. The writer has before him several practical cases in which economy has resulted.

In one colliery in the North of England, a large quantity of water had to be pumped underground by dip pumps; the company originally drove these pumps by wire ropes from engines at the pit bottom.

Upon the advice of the writer the existing pumps were converted into electrical pumps by adapting electric motors of 6 H.P., driving through machine-cut worm gearing on to the pumps.

Six sets were originally adapted in this manner to electric driving, the number being afterwards increased to eight.

The installation consisted of a horizontal steam engine of about 100 H.P., with generator, cables, and the six sets of motors and worm gears as described above, the total cost of the plant being practically £3,000, to which must be added the cost of engine house, &c., bringing the total up to, say, £3,600.

The annual saving over the old method of pumping, after allowing for interest and depreciation on electrical plant, amounted to nearly £1,200 per annum, so that the electrical machinery paid for itself in about three years. This was based on a very low price of coal, so that the saving would appear much greater at the present time, when coal is so dear.

Another example, which shows how economy can be effected by high class electrical machinery, was at a colliery in North Wales, where the writer's firm installed in the first instance a haulage plant consisting of a 300-H.P. engine, with 150-KW. generator, and 150-H.P. motor, driving an endless rope haulage gear with three rope wheels; the haulage gear dealt with about 850 to 900 tons daily output on an average gradient of 1 in 6, the gradient in some cases being as much as 1 in 3, and the total length of the three roads being about 4,470 yards.

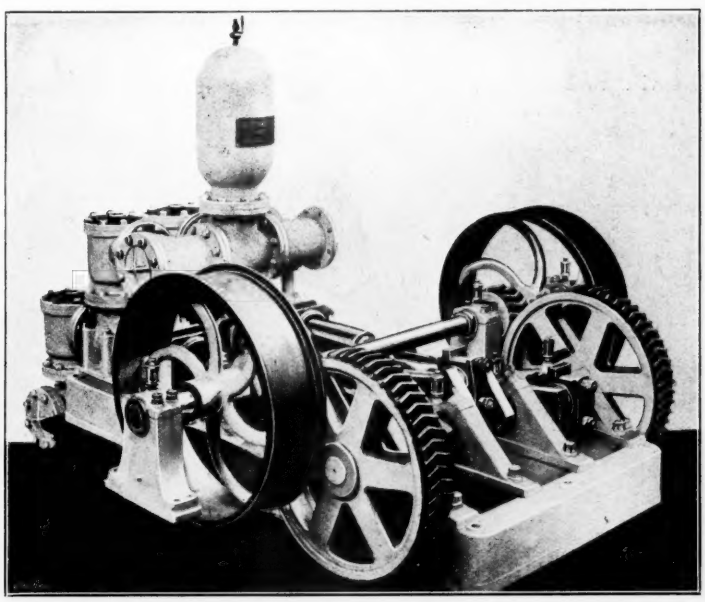


Fig. 2.

This plant has been running now for about a year and a half, and the original cost, including engines, boilers, &c., was about £8,000.

The consumption of coal for this plant is about 25 tons per week, the fuel used being the very finest screenings,

previously discarded as useless, and to make use of which the boilers were fitted with Meldrum furnaces.

The electric haulage gear took the place of an existing plant driven by wire ropes from the pit bottom, the gear being 1,200 yards in-by, and the company found, owing to the very regular running of the motor, that they were not only able to get a steadier and better supply of coal, but were effecting so great an economy in working, that they decided to order a complete duplicate of the first electrical gear, so that the haulage gear at the pit bottom, working two roads, could also be worked electrically.

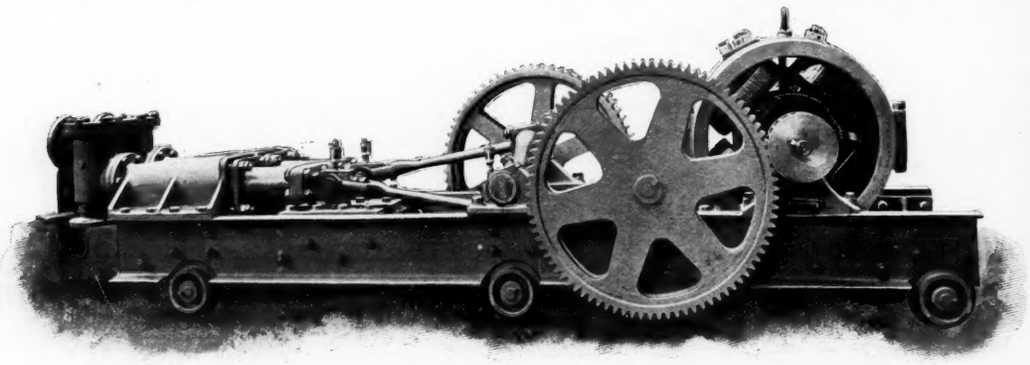


Fig. 3.

The fact that the company have spent between £13,000 and £14,000 on electrical endless rope haulage, simply with a view to increased economy in coal consumption and attendance on the machinery, speaks pretty conclusively as to its benefits.

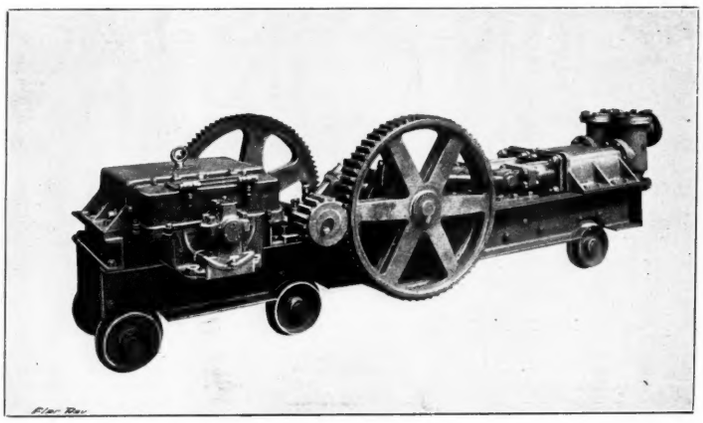


Fig. 4.

In another colliery in the North of England, where there was a range of 6-inch steam pipes leading from the boilers to an engine and pumps underground, a test was made to see exactly what was the condensation in the steam pipes; it was found that two boilers with 100 lbs. working pressure, pressed hard, were only just capable of overcoming the condensation in the pipes, and as the probable evaporation from these two boilers would be little less than 10,000 lbs. per hour, and the coal consumption probably 14 cwt. per hour, it clearly showed how very great an economy would be effected by the adoption of electrical transmission, with a loss in cables that would be almost negligible.

Careful tests were also made to demonstrate what was the condensation in the steam pipes in a pit shaft, and it was found that with well covered pipes, the condensation was approximately ⅓rd of a lb. per square foot of exposed surface, based on the outside diameter of the pipe itself.

For instance, a 6-inch pipe with an outside circumference of about 2 feet, would condense about ⅔rds of a lb. of steam per hour per foot of length.

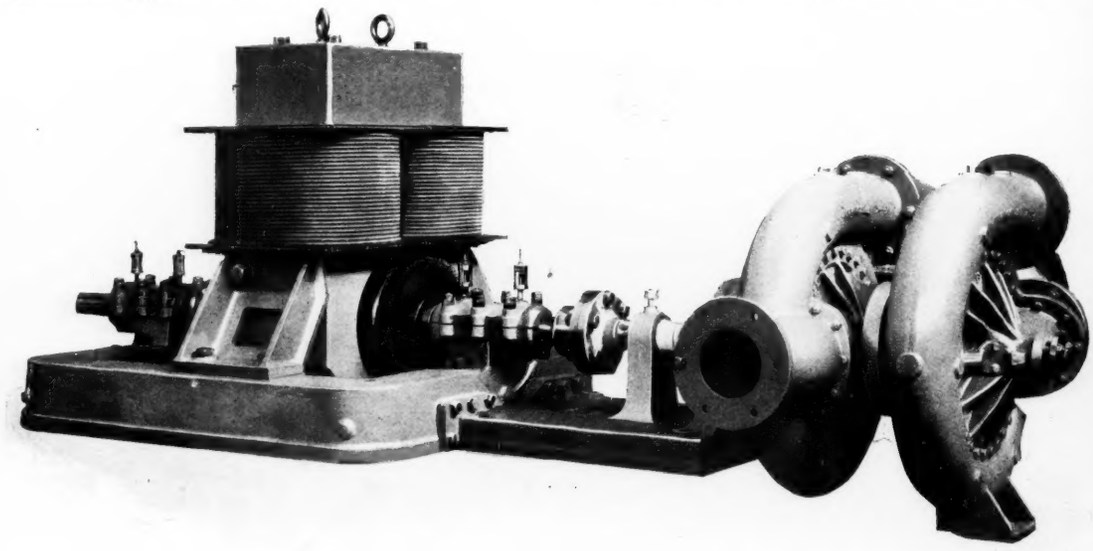


Fig. 5.

In dealing with a colliery installation, the writer has found

that it is best in all cases to provide for the plant being of very ample size, because, if it works satisfactorily, it is generally found that extensions are quickly made; and further, the very severe usage to which colliery machinery is often subject, makes the more costly plant the cheapest in the long run. It, therefore, becomes necessary to consider the best type of machinery to adopt.

The engines are the first consideration, and there is no doubt that the simpler the engine is, the better it is suited for colliery purposes, particularly as a colliery plant runs at more or less full load for 10 or 12 hours per day, and probably where pumping and hauling are worked from the same generating plant, 16 to 20 hours, because the pumping is done during one shift, and the haulage in the other.

Horizontal long stroke engines, therefore, seem to the writer to be the type which should be most favoured for colliery work, because this class of engine is better understood by the colliery engineer, and if well governed, very great demands can be made upon it without fear of breakdown.

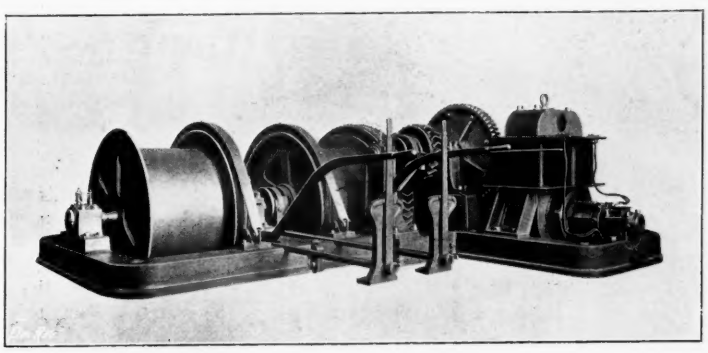


Fig. 6.

As regards the transmission of power from the engine to the generator, in small units, *i.e.*, plants up to, say, 250 KW. capacity, there is no doubt that rope driving very satisfactorily meets every condition of working, but for units over this size it is better to have the generator driven direct from the engine shaft.

Fig. 1 represents a horizontal compound engine and 350 KW. continuous current generator coupled direct, as supplied by Messrs. Scott & Mountain, and this may be taken as a good sample of a direct connected set for large powers.

For small plants, with the low steam pressures at which it is sometimes necessary to work, where colliery owners are not disposed to put in high pressure boilers, a single cylinder engine, which in any case should be fitted with a good governor, answers extremely well, and for units under 100-KW. capacity belt driving is quite satisfactory.

Makers of high speed engines and direct coupled dynamos will no doubt consider that they are being hardly used in the above statement respecting the best type of engine for colliery driving, but the writer is satisfied from a very large experience of this class of work, that high speed engines generally are not so suitable as slow running engines when they are placed in the hands of inexperienced engineers, or, at any rate, engineers having an experience only of colliery machinery; and it is generally impossible to persuade colliery owners to employ such a staff of skilled mechanics as would be necessary to attend to high speed machinery if a lot of this were installed.

Having dealt with the generating plant, the next point for consideration is the work to be done underground, which generally consists of pumping or hauling, both being very well suited for electric driving.

Fig. 2 shows a type of three-throw ram pumps which Messrs. Scott & Mountain have installed in a very large number of collieries with very satisfactory results; in the design of this pump it will be noticed that the barrels, together with the valve boxes, suction and delivery pipes and air vessel, are all independent and interchangeable, so that in the event of a breakdown the pumps can be coupled up in such a way that the mine is not liable to be flooded.

The pumps should in all cases be fitted with gun-metal rams, and gun-metal valves and seats; the glands and stuffing boxes should also be very long and substantially bushed.

All mining pumps should also have cross-heads with large slippers working in oil wells to provide continuous lubrication, and the bearing surface in the cross-head gudgeon and crank-pins should be very ample and quite up to engine practice.

For high lifts, *i.e.*, from 500 feet head upwards, the writer has usually provided for driving the pumps with double gearing, *i.e.*, a spur wheel at each end of the crank-shaft, and, in later practice, machine-cut gearing has been used throughout. Fig. 2 shows the high lift pumps with double belt drive and double gearing.

As regards the transmission of power from the motor to the pump, it is desirable to have an elastic medium, such as a driving belt or driving ropes where the plants are of large size, because this takes up the very severe shock on starting off the armature, and is also better for the working of the pumps.

Fig. 3 represents a type of three-throw pump geared direct to an electric motor, this set having been designed to deliver 70 gallons per minute against a head of 1,000 feet.

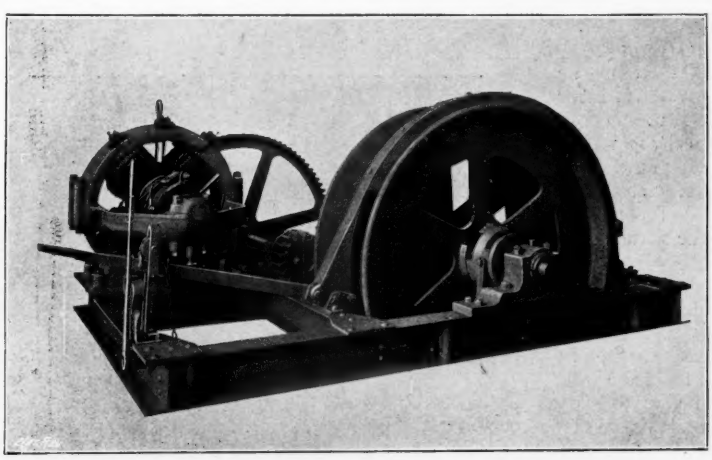


Fig. 7.

For lower lifts—*i.e.*, anything below 500 feet head—it is not necessary to have double gearing on the pumps; but it is always desirable, seeing that machine cut gearing can now be cut out at a cost not appreciably more than that of cast gear, to adopt the higher finish, as the running of the machinery is in every way sweeter and more satisfactory.

The pumps shown in fig. 3 are suitable for high-lift work—that is, for any head up to 1,000 feet. In most collieries it has been found necessary at some time or other to arrange for the unwatering of an old working, or to deal with an accumulation of water in dips, or dooks as they are sometimes called in Scotland, and slants in other parts of England. For this work the type of pump shown in fig. 4 is specially suitable, the set illustrated having been specially designed by the writer for this purpose.

This type of pump, which will work against any head up to 300 feet, is of the double-ram type, and a large

number of similar sets are working satisfactorily in different parts of the United Kingdom. They are compact, and have the advantage that the two side girders forming the bedplate can be quickly uncoupled, and shifted about the pit with very little trouble.

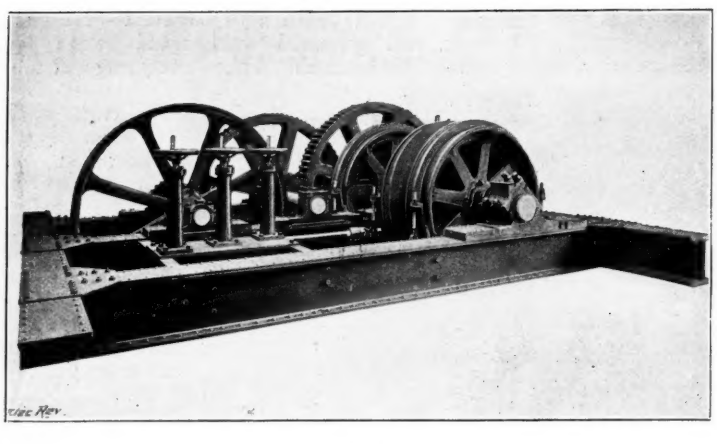


Fig. 8.

At an ironstone mine in Yorkshire, which had been flooded, a system of pumping which answered very well was adopted, by the writer's advice, to clear the workings of water, the type of pump and motor employed being shown in fig. 5.

This pump was designed to deal with 1,000 gallons of water per minute against a head of 150 feet, and ran at a speed of 700 revolutions per minute, being driven by an electric motor capable of giving 100 H.P.

The motor in this case was constructed larger than was really required to drive the centrifugal pump, but this was merely a temporary arrangement, the full power of the motor being utilised later for the permanent pumping.

The mine being flooded, and the dip being 3 inches to the yard, and it being necessary to have the pumps portable, this type of plant was suggested; in practice the pumps were lowered each 80 yards, which, at 3 inches to the yard, is equivalent to a total suction of 20 feet vertical head.

The inlet and outlet branches of the pump consisted of flexible rubber pipes, the total length over flanges being 27 feet, so that the rising main was laid as the pumps were gradually taken in-by; after each removal of the pumps, three 9-feet lengths of pipe took the place of the position where the pumps had stood, the suction pipes then forming the rising main.

The next important branch of work in collieries is haulage: this consists of either main and tail, tail rope, or endless rope gears, and the accompanying illustrations represent the different types.

Fig. 6 shows a main and tail winding gear, consisting of two drums, each fitted with clutches and brake strap, driven by an electric motor through worm gearing. The worm gear in this case was adopted as the speed was very slow, but for higher speeds the writer recommends machine-cut spur gearing.

Fig. 7 represents a tail drum haulage gear with single drum, fitted with clutch gear and brake strap, and driven by a semi-enclosed electric motor; in this instance it will be noticed that machine-cut gearing is used.

In endless-rope haulage it is quite customary for the haulage gear to have to deal with one, two, and some times three roads, and in this case it is necessary that the gear should be fitted with independent rope wheels for each main road, though it is possible that along the roads vertical or horizontal shafts with pulleys may be fitted to deal with subsidiary haulages. The following illustrations represent the type of gears most suitable for this purpose.

Fig. 8 represents an endless rope haulage gear for three roads; fig. 9 a similar gear, but for two roads.

Where the roads are straight and there is a double line of rails there is little doubt that endless-rope haulage in point of economy, power and general convenience in working is much to be recommended. This can be easily understood when we consider that the quantity of coal to be delivered to the pit bottom is so many foot-pounds per minute, the delivery being continuous in the case of an endless-rope gear, while with main and tail it is, of course, necessary to run back the empties and bring up the full tubs, the tubs being brought up in trains and these trains coming up at intervals. Therefore where it is possible to adopt endless-rope haulage it is undoubtedly the best system, although many colliery

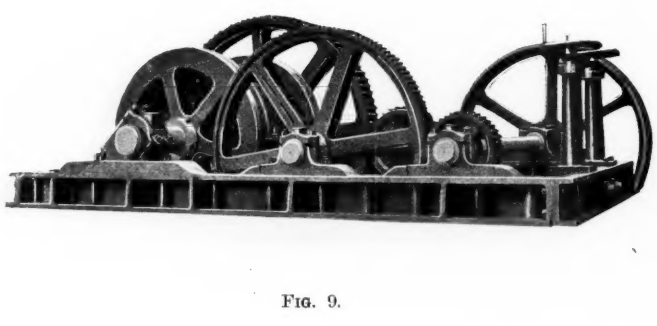


Fig. 9.

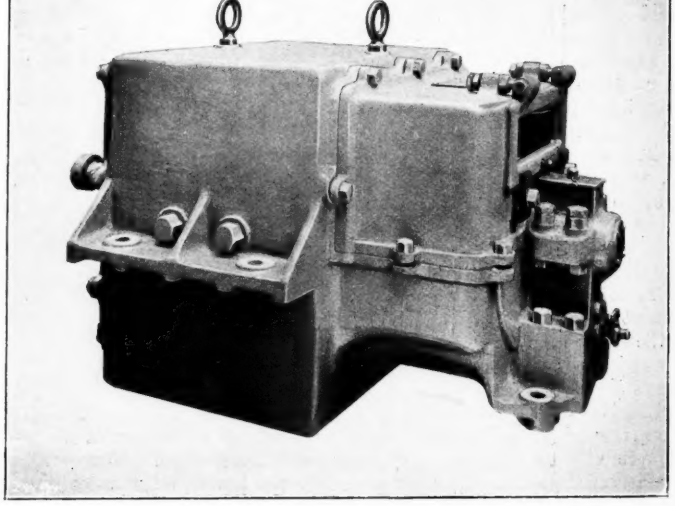


Fig. 10.

engineers, who the writer ventures to think have not considered the matter very carefully, still consider that main-and-tail haulage gears are the most satisfactory.

So far the writer has not touched on the relative advantages of continuous or three-phase alternating currents for mining work. There is no doubt that continuous current working, particularly where the machinery is well designed and of large enough capacity, is extremely satisfactory, and the only advantage which the advocates of the three-phase system can bring forward is that they have no commutators, but in the writer's opinion, this is a somewhat misleading way of looking at it, as there is no reason why commutators should give any trouble if well designed and looked after.

Against the supposed disadvantages of continuous current on account of the commutators, we have the complication in the three-phase system of a greater number of wires or cables, and also line losses with motors under moderate loads, which very often occurs in mining work, and which losses are very considerable ; this loss does not occur with continuous current machinery.

Of course, where power has to be generated at a long distance from the colliery, or the scheme is one of general distribution over a number of pits some distance from a given centre, there is no doubt that three-phase transmission is the most satisfactory, as it is difficult to construct continuous current machines with a sufficiently high voltage to obtain such economical results as may be obtained with high tension three-phase alternating currents.

The application of electricity to coal cutting in collieries will also, no doubt, be very largely adopted in the near future, as from the trials of plant which have been installed by the writer's firm and other recently, there is no doubt that a very large saving can be made in the cost of coal winning when the conditions of working are favourable, the principal conditions being that the floors and roofs are both good and fairly level, as any serious faults are liable to cause difficulties which prevent coal cutting from being successfully carried on.

Various types of coal cutters have been used with greater or less success, but up to the present the tendency seems to be to adopt machines with revolving discs. These discs are arranged to cut from 3 feet under up to as far as 5 feet 6 inches, and run at a cutting speed on the periphery of the disc of about 300 feet per minute.

The disc is generally fitted with 24 cutters, half of them being single and the other half forked, so that the groove which they cut in the coal or fire-clay is about 5 inches wide.

Fig. 10 represents a type of coal cutter, of which over 70 are at work in various collieries.

The cutter is driven by an electric motor of 23 to 25 H.P. in normal working, but as coal cutting is naturally very severe on any motor, it is necessary that the machines should be capable of giving fully 30 to 40 H.P. without danger for short periods when the cutter wheel gets jammed.

The type of coal cutter illustrated is only used for the long-wall system of working; but as this method is being more or less adopted universally, there is only a very small demand for machines to work on the board and pillar or pillar and slate system.

It is found in practice with disc coal cutting, which is the type illustrated, that the motor requires from 50 to 60 amperes at the terminals, with an E.M.F. of 420 to 450 volts.

A coal-cutting machine, when in fair working order, and handled by men accustomed to the work, should be capable of cutting from 60 to 80 yards ; but under favourable conditions, where the undercutting is soft, the machines will cut up to 120 yards per shift.

In this paper it has been impossible to deal with the many smaller items constituting an installation, such as the class of cables, method of running same, type of switches to be used and so on ; but as these will vary so much with the special conditions under which the plant has to work, it really becomes a question of deciding in each individual case what will be best suited to the requirements of the mine.

Leith.—The bonding of the Tramway Company's rails for electric traction is now to be proceeded with.

CONTRACTS OPEN AND CLOSED

(*Continued from page* 238.)

Cologne.—February 12th. The Prussian State Railway administration will, on this date, consider bids for the following supplies:—226,000 kilos. of galvanised iron wire, 27,000 kilos. of copper wire, 6,070 kilos. of isolated wire, 55,400 porcelain insulators with or without supports, 19,100 screw supports in iron, 800 double ditto, and 320 kilos. of cable. Conditions and contract forms can be had on application to the office of the Administration, 28, Domhof, Cologne, price 80 mark (8d.).

Croydon.—February 16th. The Borough Council wants tenders for two dryback boilers for the electricity works. See "Official Notices" February 1st.

Edinburgh.—February 9th. The Corporation invites tenders for an engine and dynamo for the McDonald Road electricity works. See "Official Notices" January 11th.

Glasgow.—It has been decided to add a 3-ton electric wharf crane to the equipment of the Prince's Dock, and offers are invited.

Glasgow.—February 22nd. The Corporation wants tenders for the supply of 100 car equipments and spare parts for same. See "Official Notices" February 1st.

Holland.—March 25th. Tenders are being invited until March 25th next by the municipal authorities of Amsterdam, for the equipment of a central electric lighting station in the city.

Hornsey.—February 11th. The U.D.C. invites tenders for the necessary works for providing forced draught to their refuse furnaces.

Hull.—February 8th. The Works Committee wants tenders for a multipolar generator, to be coupled direct to a Belliss high speed engine, for the tramways undertaking. See "Official Notices" January 18th.

Launceston (Tasmania).—April 22nd. The Corporation wants tenders for the supply of 500 electric meters. See "Official Notices" January 11th.

L.C.C.—February 19th. The L.C.C. wants tender for the supply of two blocks of water-tube boilers for the tramways generating station at Camberwell. See "Official Notices" January 25th.

Long Eaton.—The U.D.C. wants tenders for producers, gas engines, dynamos, and switchboard, feeder and distribution cables, and conversion of street lamps. See "Official Notices" January 25th.

Luton.—March 4th. The T.C. wants tenders for electrically lighting the Council Chamber, Town Hall, Free Library, Corn Exchange, and Baths. See "Official Notices" January 18th.

Luxembourg.—The communal authorities of Rumelange in the Grand Duchy of the Luxembourg are at present preparing plans for the construction of an electric lighting station. The adjudication will be announced at an early date. Particulars may be had on application to the communal administration.

Malta.—February 15th. The Receiver-General and Director of Contracts, Valletta, invites tenders for the supply of 75,000 arc lamp carbons. Particulars, specifications, &c., may be obtained on application to the Superintendent of Public Works, in Malta, or to the Crown Agents for the Colonies, Downing Street, London.

Manchester.—The Ship Canal Warehouse Company wants tenders for 22 electric jib cranes.

Nelson.—February 11th. The Corporation wants tenders for a storage battery. See "Official Notices" February 1st.

New South Wales.—February 22nd. The *New South Wales Government Gazette* announces that tenders will be received at the offices of the Department of the Public Service Tender Board, 42, Young Street, Sydney, for the supply of (1) Telegraph material; (2) Telephone material; (3) Electric light material, all for the years 1901-2. Tender forms may be obtained and samples seen at the office of the Chief Electrican, General Post Office, George Street, Sydney. Samples may also be seen at the Postal and Electric Telegraph Stores, George Street, Sydney. The conditions as published in the *Gazette* may be examined on application at the Commercial Intelligence Branch, Board of Trade, 50, Parliament Street, London, S.W., any day between the hours of 10 a.m. and 5 p.m.

New South Wales.—March 4th. The *New South Wales Government Gazette* states that tenders will be received at the Railway Commissioners' Office, Bridge Street, Sydney, until Monday, March 4th, 1901, from persons willing to contract for the supply, delivery, and laying of about 29 miles of 6,600-volt three-core lead-sheathed cable, and of about two miles of other cables, together with the necessary troughing, filling-in compound, armouring, &c.

Poplar and Stepney.—The managers of the Poplar and Stepney Sick Asylum wants tenders from firms willing to perform certain work in connection with the asylum installation. See "Official Notices" January 25th.

Southampton.—February 11th. The Corporation wants tenders for car bodies and trucks, motors and equipments. See "Official Notices" January 25th.

Southwark.—February 13th. The Electric Light Committee wants tenders for a 400-kw. high speed engine and dynamo, two water-tube boilers, mechanical stokers, steam mains, &c. See "Official Notices" January 25th.

Spain.—February 21st. The Secretary for Foreign Affairs has received a dispatch from H.M. Ambassador at Madrid, stating that tenders are invited by the Spanish Government, not later than February 21st next, for the establishment of a telephone system in the City of Huelva; particulars at the Commercial Department, Foreign Office.

Taunton.—February 25th. The Corporation wants tenders for two 100-kw. tramway generators, one engine, switchboard and connections. See "Official Notices" to-day.

The Hague (Holland).—March 25th. The Communal Council administration wants tenders for the supply and erection of engines and electric plant for the electric lighting of the town.

Stockholm.—February 15th. The Secretary of State for Foreign Affairs has received a despatch from His Majesty's Consul at Stockholm stating that tenders are invited by the German Telephone Company of Stockholm, not later than February 15th, for the supply of telephone cables of the following description:—13,000 to 15,000 metres, 250 pair, c.i.f., Stockholm; 1,000 metres (armoured), 250 pair, c.i.f., Stockholm; 4,000 metres, 100 pair, c.i.f., Stockholm. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Stirling.—February 15th. The T.C. invites tenders for two 350-h.p. engines and dynamos, and Lancashire boilers 28 feet × 8 feet. See "Official Notices" to-day.

Wallasey.—February 21st. The U.D.C. wants tenders for the erection of car sheds, workshops, &c., also for extension of the electricity works (buildings and plant, including boiler, condensing plant, cooling tower, crane, engines and dynamos, cables, economisers and transformers). See two "Official Notices" January 25th.

Wimbledon.—February 18th. The U.D.C. wants tenders for the supply of steam and other piping; moving boilers, pumps, &c.; also supply of surface condensing plant and two water-tube boilers for electricity works extensions. See "Official Notices" January 18th.

Wolverhampton.—February 11th. The Tramways Committee wants tenders for a 10-ton electric travelling crane (500-volt direct current circuit) at the new car depôt. Specifications, &c., from the borough engineer.

CLOSED.

Aberdeen.—The T.C. has accepted the tender of the E.P.S. Company, for the supply of two storage batteries, for the sum of £6,032, which also covers maintenance for 5 years. Mr P. Tawse, a local contractor, has secured a contract for certain works in connection with the tramways permanent way construction at £7,765.

Belfast.—Messrs. Mechan & Sons, Glasgow, have secured the pipework contract for the extension at the Corporation Supply Station.

FORTHCOMING EVENTS.

Friday, February 8th.—At 8 p.m. Institution of Junior Engineers. Westminster Palace Hotel. Paper on "Electric Power Supply in the Metropolis," by L. F. Awde, member of Council.

Synopsis:—Extent of electric power at present supplied by Metropolitan companies—Provision for encouraging the adoption of electric power—Difficulties—Cost—Municipal influence—Situation of manufacturing districts—The coal question—Proposal to establish two large central stations for power supply, with generators on the three-phase system, at extra high voltage, the current transmitted to distributing centres and there transformed as required—Description of the stations—Mains, &c.—Capital cost and working charges—Losses in Distribution—Economy obtained—Conclusions.

At 9 p.m.—Royal Institution. A discourse will be delivered by Prof. G. H. Bryan, F.R.S., on "History and Progress of Aerial Locomotion."

Institution of Mechanical Engineers. Extra meeting. Conclusion of discussion on Mr. Humphrey's paper on "Power Gas and Large Gas Engines for Central Stations."

Saturday, February 9th.—At 3 p.m. Institution of Electrical Engineers (Students' Section). Visit to the generating station and depôt of the Central London Railway at Shepherd's Bush.

Wednesday, February 13th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Meeting at the rooms of the Institution of Engineers and Shipbuilders, 207, Bath Street.

At 7.30 p.m. Institution of Electrical Engineers (Students Section).—Papers to be read:—"Electro-Chemistry at the Paris Exhibition of 1900," by M. Solomon, and "Accumulators at the Paris Exhibition of 1900," by J. H. West.

Thursday, February 14th.—At 8 p.m. Institution of Electrical Engineers. "Capacity in Alternate Current Working," by W. M. Mordey, member. Adjourned discussion.

Friday, February 15th.—At 9 p.m. Royal Institution of Great Britain. "Electric Waves," by Right Rev. Monsignor Gerald Molloy, D.D., D.Sc.

At 8 p.m. Institution of Mechanical Engineers, Storey's Gate, S.W. Paper on "Light Lathes and Screw Machines," by Mr. John Ashford, A.M.I.Mech.E. Syllabus:—

Introduction.—Requirements of light lathes, of turret lathes, and of automatic screw machines—Wearing parts—The spindle and bearings—Thrusts—Adjusting or gib-strips—Slide surfaces and lathe-bed sections—Release-nut clutches—Speed variation—Friction back-gear—Changes of traverse—Saddles—Loose headstocks—Combined nut-release and quick-withdraw.

Turret Lathes.—Different forms of collet-chucks—Stock feed—Turrets—Flat turret lathes—Swedish turret lathe—Hollow hexagonal turret lathe—Cross-turret lathe—Inclined-turret lathe—Turret traverse—Cross slides—Leader-screws.

Full Automatic Screw Machines.—Headstocks—Automatic turrets—The "Herbert"—The "Cleveland"—The "Wolseley"—The "Brockie"; and other automatic screw machines.

NOTES.

The Institution of Electrical Engineers (Dublin Section).—The following resolution was passed at the meeting of the Dublin Local Section on the 24th ult. Proposed by Mr. Porte and seconded by Mr. Ruddle:—

That we, the Dublin Section of the Institution of Electrical Engineers desire to record the deep grief with which we have received the news of the death of our late beloved Sovereign, Queen Victoria, and that this meeting do forthwith adjourn as a mark of our sorrow.

Also that if the Central Institution propose to present a vote of condolence with the Royal Family, it is the desire of this Section to heartily endorse the same.

Proposed National Electrical Contractors' Association.—A movement is on foot for the formation of a National Electrical Contractors' Association, and an enthusiastic meeting of the originators of the scheme was held in Anderton's Hotel, Fleet Street, London, on Friday afternoon. Representatives were present from Birmingham, Glasgow, Leeds, Manchester, Newcastle, Sheffield, West Hartlepool, &c. Some interesting information was given as to the associations which have already been formed in various districts. A provisional committee was appointed to draw up a preliminary set of rules governing the conduct of the proposed National Association, and a meeting will be convened at a later date to inaugurate a National Association to embrace all local associations in Great Britain and Ireland. Further information regarding the scheme can be obtained on application to the convener, Mr. Thomas Guthrie, C.A., 46, Queen Victoria Street, E.C.

Electrical Standardising, Testing and Training Institution.—The Board of Control of this Institution have awarded Joseph Goodman, of Wellingborough Grammar School, a Maxwell Entrance Scholarship, value 50 guineas, tenable for two years; and Francis Norman Wilson, of Felsted School, a special prize of 10 guineas.

Paris Exhibition Honours.—The *Electrical World* says that the list of decorations bestowed on Americans by the French Government in connection with the Paris Exposition, has just been published. J. P. Morgan and F. J. V. Skiff are made officers of the Legion of Honour. Among the chevaliers of the Legion are F. E. Drake, C. A. Moore, C. A. Griscom, C. A. Coolidge, Carl Hering, F. C. Pratt, E. W. Rice, jun., Ambrose Swazey, and George Westinghouse.

The Use of Electricity in Berlin and London.—A Comparison.—The conditions prevailing in Berlin with regard to the supply of electricity differ very widely from those obtaining in London, and it is interesting to see whether such conditions are conducive to the wider use of electricity. The most prominent feature in the electric lighting of Berlin is that one company supplies the whole of the electrical energy, whether used for lighting, power, or tramway purposes. In the financial year ending 1899-1900 the report of the company shows that the number of kilowatt-hours consumed in lighting was 11,201,660. In making a comparison with the annual current consumption in London we are obliged to take the figures of the companies for the year ending 1899 ; the Vestry supply undertakings bring their figures, however, down to March, 1900, and no doubt the aggregate will enable us to make a fair comparison with the German figures. The total current consumption in the districts of the 11 metropolitan companies (exclusive of the London Electric Supply Corporation) for the year ending 1899 was roughly 38 million kilowatt-hours, which is more than three times that of Berlin. If we add the municipal systems, the total is brought up to 46 millions. Apart from the fact that the area over which the London supply systems extend is a very enormous one compared with Berlin, one has to remember that the metropolitan figures which we have just quoted include street lighting and power, and if the electricity used for such purposes in Berlin is added to the Berlin figures the total consumption is brought up to 29 millions, which, considering the disparity of the population in the two cities, is distinctly favourable to the German town. But the remarkable fact in Berlin is that 48 per cent. of the electric energy used is on the electric tramway systems ; indeed, when the tramway consumption is added to the foregoing figures the total consumption is 42 million units, and the fact that it is produced by one company is enough to make London companies somewhat envious. It is interesting to reproduce the following table, which shows the purposes for which electricity has been utilised during the past few years :—

Year.	Private lighting.	Street lighting.	Power purposes.	Electric tramways.
1895-6 ...	6,908,655	385,594	2,219,501	257,050
1896-7 ...	8,094,243	408,381	4,008,943	1,758,250
1897-8 ...	9.315,129	424,639	5,833,077	2,443,421
1898-9 ...	10,143,377	484,591	7,758,662	10,166,652
1899-0 ...	11,201,660	881,811	17,240,284	20,169,484

It will be seen that the chief use of electricity in Berlin is for traction purposes—a sufficient indication of the difference between the conditions of London and Berlin as regards tramways. The average price paid per kilowatt-hour for electricity consumed is 21·55 pfennigs, or practically 2½d. per unit, which is considerably lower than the price obtained in London. No doubt the average rate in Berlin is materially affected by the extremely low price at which current is supplied to the tramways, the charge being ·9d. per kilowatt-hour. The cost of production, however, is 4·89 pfennigs, which is lower than the cost in any public electricity works in this country. The net profits of the company were M2,810,000, notwithstanding that a total sum of M1,548,867 was paid to the city authorities as their share of the profits. The whole supply of electricity is carried on from two main generating stations and five transformer sub-stations, which have a total capacity of 25,250 KW.

Pneumatic Tubes.—The *Board of Trade Journal* quotes from the *Iron Age* (New York) that application for a charter for the Electro-Pneumatic Company, of Connecticut, has been made to the General Assembly of that State. The company propose to inaugurate a service for the transmission of merchandise and other articles through pneumatic tubes. The plan is to run the main tube from New York to Hartford, through Bridgeport, New Haven, and Meriden. One of the features of the project would be the practically instantaneous delivery of newspapers from New York to the large cities in Connecticut.

Glasgow Exhibition.—For power purposes, throughout the Exhibition, there will be some 70 motors of various sizes from 1½ to 200 H.P. The makers include the names of many well-known British and Foreign manufacturers. For the smaller sizes 250 volts, and the larger sizes 500 volts, is the pressure of supply. The contracts for the lighting of the pavilions and restaurants in the grounds have now been fixed, and they go to local contractors.

The Pacific Cable Project.—The *Times* Melbourne correspondent says that Mr. Chamberlain has telegraphed to Sydney that Canada is considering her position as a contracting partner in the Pacific cable in view of the concessions granted to the Eastern Extension Company.

American Rails for the G.E.R.—The *New York Herald's* Pittsburg correspondent says that the Carnegie Company has started rolling 8,000 tons of steel rails ordered for the Great Eastern Railway. This is the first order received by the company from England itself.

Royal Society.—Among the papers read yesterday afternoon were:—Prof. Dewar, F.R.S., on "The Boiling Point of Liquid Hydrogen, determined by Hydrogen and Helium Gas Thermometers." Prof. Love, F.R.S., on "The Integration of the Equations of Propagation of Electric Waves."

Personal.—Mr. W. McClelland has resigned his position at the Manchester Corporation electricity works, after 13 years' service with the Corporation, having been connected with the undertaking since its inception.

Mr. F. S. Ransome, who for the last five years was assistant manager of the Brush Electric Engineering Company, Limited, works at Loughborough, has been appointed general manager to the Clayton Engineering and Electrical Construction Company, Limited, of Newton, Hyde, and Clayton, near Manchester.

Mr. A. C. Taylor, who has been for several years with Messrs. James Milne & Son, Limited, gas, water, and electric fittings manufacturers, and for the last five years manager of the company's branch at Edinburgh, was entertained to dinner by a number of his colleagues on Friday at Leith, on the occasion of his leaving to take up an appointment with Messrs. Falk, Stadelmann & Co., Limited, of London. The company's employés presented Mr. Taylor with a gold watch.

Mr. W. A. Tester, of Plymouth, has been appointed tramway and electrical engineer at Lancaster at a salary of £300 per annum. Mr. Fraser, the electric lighting engineer, returned from South Africa last week and resumed his duties.

Mr. John Lambert, assistant at Dundee electricity works, has been appointed electrical engineer to Perth Town Council.

It will no doubt interest many of our readers to learn that M. von Dolivo-Dobrowolsky, who has been so long associated with that large electrical concern—The Allgemeine Elektricitäts Gesellschaft—has left Berlin to take up new duties at Riga, in Russia.

We understand that Mr. Herbert Lindley, late of Browett, Lindley & Co., Limited, of Patricroft, has accepted the position of general manager to Galloways, Limited, Manchester, who are taking up the construction of high-speed engines for electrical installations.

Mr. A. W. Whieldon has resigned his post as managing engineer to the Kidderminster and District Electric Lighting and Traction Company, having been appointed electrical engineer to the Great Northern Railway Company (Ireland)

For Sale.—Messrs. Wheatley Kirk, Price & Co. will shortly sell a quantity of machinery, &c., of a well-known London electrical manufacturing firm.

The Kensington and Knightsbridge Electric Lighting Company are offering for sale two Babcock boilers, a 154-KW. Willans-Siemens set, four Willans-Crompton sets, &c. The prices are stated in our advertisement pages to-day.

A Welcome Innovation.—The beginning of the new century is aptly signalised by the introduction of a new monthly journal, entitled *The Electro-Chemist and Metallurgist*, whose objects are sufficiently revealed by the title. The first number contains articles on "Recent Progress in Electro-Chemistry;" "The less well-known Carbides, Borides and Silicides;" "Electro-Chemistry at the 1900 Paris Exhibition;" and a number of short articles on various electro-chemical matters, abstracts of patents, trade reports, &c. Considering that in Germany, as the editor points out, there are already two or three periodicals devoted to electro-chemical subjects, we must admit that there was a gap in our technical literature; we confidently anticipate that, in the hands of its able editor, the new journal will wipe out this reproach. We wish it all prosperity.

The "British" Westinghouse Works.—The *Western Electrician* says that the British Westinghouse Electric Company, of Manchester, has sent out invitations for bids for over $500,000 worth of machine tools for its new works on the Bridgewater Canal in Manchester. "Contracts for the engines have already been awarded to the Westinghouse Machine Company, of Pittsburg, and it is probable that nearly all the tools needed by the concern will be furnished by United States manufacturers." The capacity of the plant will be about 80 per cent. of the East Pittsburg plant of the Westinghouse Company. The intention of the company is to manufacture the same products as the Westinghouse Machine and Electric Companies do at East Pittsburg, with the exception of steam turbines.

New Cable Works at Leigh.—Leigh, which will form the centre of the South Lancashire Electric Tramways Company's extensive system, their generating station being there, is to have a new industry, the making of electrical cables. The Anchor Cable Company, Limited, has this week been formed with a capital of £50,000 to carry on business at Leigh. The directors including Councillor George Shaw, Mayor of Leigh, Messrs. R. A. Rumney, W. E. Rumney and W. M. Henderson.

Naval Boilers.—A *Pall Mall Gazette* correspondent says that it seems not improbable that the Belleville boiler will be eventually discarded from the Navy. This is no more than we ourselves have long foreseen. The same writer says that the Boiler Committee has been favourably impressed by experiments with the Niclausse boiler. We also read that Admiral Melville, of the United States Navy, has unreservedly condemned the Belleville. We shall return to this subject next week.

Obituary.—It is our duty to record—and we do so with great regret—the sudden death of Prof. Elisha Gray, whose work in connection with the telephone, and later with the telautograph, is common knowledge. The last year of his life found him at work upon submarine signalling and sound detecting apparatus. He was 65 years of age, and death was due to heart failure.

The Schuckert Contact System.—The Greenwich Borough Council will oppose the South-East Metropolitan Tramway Company's proposal to employ the Schuckert electric system between Greenwich and Catford, on the ground of road disturbance.

Lecture.—Prof. Oliver Lodge, D.Sc., F.R.S., lectured to a crowded audience at the Newcastle Lit. and Phil. on 30th ult. on "Wireless Telegraphy."

Appointment Vacant.—The Dundee Gas Commissioners want a shift engineer for the lighting and traction station.

Huddersfield Trams.—Yesterday, Thursday, the municipal electric tramways at Huddersfield were formally inaugurated by the Mayor.

NEW COMPANIES REGISTERED.

Howard Conduit Company, Limited (69,270).—This company was registered on January 26th, with a capital of £20,000 in £1 shares (1,000 deferred), to acquire the benefit of an indenture of licence made between A. H. Howard, of the one part, and W. T. Glover & Co., Limited, of the other part, to make, use and exercise a certain invention for improvements in, and apparatus for, the manufacture of pipes or conduits for electrical conductors, or for conveying liquids or gases, or for analogous purposes, to acquire the benefit of a memorandum of agreement between the same parties, and to carry on the business of pipe and conduit manufacturers, electrical engineers, electricians, contractors, suppliers of electricity, &c. The first subscribers (each with one share) are:—J. E. Latham, 12, Northen Grove, West Didsbury, engineer; J. H. C. Brooking, 85, Northumberland Road, Old Trafford, engineer; E. J. Flanagan, 65, Harriet Street, Stretford, clerk; C. K. Hamilton, 51, St. Bees Street, Manchester, traveller; A. E. Tanner, 7, Talbot Road, Old Trafford, engineer; W. C. Mann, Calder Bank, Ashton-on-Mersey, accountant; and J. B. Hyde, 33, Stamford Street, Old Trafford, engineer. The number of directors is not to be less than three nor more than seven; the first are H. Edmunds, W. P. J. Fawcus, A. H. Howard and E. A. Claremont; qualification, £100; remuneration, £200 per annum, divisible. Registered office, Trafford Park, Manchester.

Primitiva Gas and Electric Lighting Company of Buenos Ayres, Limited (69,267).—This company was registered on January 25th, with a capital of £1,200,000 in £5 shares (160,000 preference) to adopt an agreement between La Compañhia Primiyiva de Gas de Buenos Ayres of the one part, and H. Ward of the other part, to acquire gas or electric light works in the River Plate and other countries in South America and elsewhere, and to carry on the business of manufacturers, generators, and suppliers of gas, electricity, and other illuminants and force, engineers, engine and machinery builders, gas and electric stove makers, wharfingers, contractors, &c. The first subscribers (each with one share) are:—A. J. Anderson, 31, Throgmorton Street, E.C., gentleman; A. F. Farish, 57½, Old Broad Street, E.C., solicitor; T. C. C. Richards, 41, Martin Road, Woodside, clerk; W. S. Wild, 33, London Road, Clapton, N.E., gentleman; L. H. Grundy, Claremont House, South Hampstead, solicitor; R. H. Eggar, 31, The Chase, Clapham Common, S.W., solicitor; and C. J. Whitaker, Springfield, Aulaby Road, Teddington, solicitor. The subscribers are to appoint the first directors; qualification, £500.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

African Trans-Continental Telegraph Company, Limited (37,855).—This company's annual return was filed on January 2nd, when 170,300 shares were taken up out of a nominal capital of £300,000 in £1 shares; £1 per share has been called up, resulting in the receipt of £169,315, including £10 paid on 20 forfeited shares; £995 remains in arrears.

Bright's Light and Power, Limited (58,290).—This company's annual return was filed on January 21st, when 100,000 ordinary shares were taken up out of a nominal capital of £200,000 in £1 shares (100,000 ordinary and 100,000 preference); £1 per share has been called up on 66,667, resulting in the receipt of £66,489 5s.; £177 15s. remains in arrears; £33,333 is considered as paid on the remaining shares; mortgages and charges, *nil*.

Bullers, Limited (62,020).—This company's annual return was filed on December 24th, 1900, when 15,000 preference and 15,000 ordinary shares were taken up out of a nominal capital of £400,000 in £10 shares (20,000 preference). £10 per share has been called up on 15,000 preference and 7 ordinary, resulting in the receipt of £150,070. £149,930 is considered as paid on the remaining 14,993 ordinary shares.

Central Electric Supply Company, Limited (53,080).—This company's annual return was filed on January 7th, when the entire capital of £100,000 in £5 shares had been taken up. £3 2s. 6d. per share has been called up on 19,692, £1 per share on 300, and £5 per share on 8 shares, resulting in the receipt of £61,877 10s. Mortgages and charges, *nil*.

Electric Fur Machining Company, Limited (53,742).—This company's annual return was filed on January 14th, 1901, when 566 shares were taken up out of a nominal capital of £3,600 in £1 shares. £1 per share has been called up on 16, resulting in the receipt of £16. £550 is considered as paid on the remainder. Mortgages and charges, *nil*.

Kirlew Brothers, Limited (49,449).—This company's annual return was filed on January 14th, 1901, when 2,500 shares were taken up out of a nominal capital of £5,000 in £1 shares. £1 per share has been called up on seven, resulting in the receipt of £7. 10s. per share is considered as paid on 300, and £1 per sharge on the remaining 2,193. Mortgages and charges, *nil*.

Monte Video Telephone Company, Limited (27,208).—This company's annual return was filed on November 15th, when 86,492 preference and 72,680 ordinary shares were taken up out of a nominal capital of £160,000 in 87,000 preference and 73,000 ordinary shares of £1 each. All shares are considered as fully paid.

CITY NOTES.

The City and South London Railway Company.

The meeting of this company was held at 71, Finsbury Pavement, E.C., on Tuesday last, Mr. C. G. Mott presiding.

The Chairman, after alluding in appropriate terms to the loss of the Empire in the death of the Queen, dwelt upon the advance of steam and electricity in their application to traction during the Victorian era, and remarked that in H.M. the King we we had one who had opened the C. and S.L. line 10 or 12 years ago, and he trusted that that was only the beginning of great works in which Edward VII. would help. Turning to the company's affairs, the chairman said that some of the shareholders might be disposed to wonder why, after paying 2½ per cent. when they had a little line of only three miles long, they had reduced the dividend now that the line was extended. They knew when they had their little line that their only safety was in extending it. They had exercised great caution and prudence in carrying out those extensions at a very slow rate. The Islington extensions would be finished in six months, and then they would see the whole thing as they had been designing it from the beginning, a complete undertaking. For some time past they had been afraid of what might be the result of the intermediate stage of the extensions during the past half year and the one now current. They had been able to get round the corner which they dreaded, with only a diminution of ⅞ per cent. in the dividend. After the half-year, as soon as they get the Islington section opened, he thought they might fairly look forward to a very different, steadily growing and improving condition of things, and in the end it would be seen that the policy of carefully designed and slowly carried out extension would result in a satisfactory state of things in the future. Most of the Islington tunnelling was completed. They had now to lay the permanent way, to fix the electrical conductors and cables, the lifts, and build surface stations. With regard to the City & Brixton Railway, with which they had made some arrangement in order to utilise that portion of the line now standing idle, the condition of the money market had been such that it was not prudent to attempt to raise the money for it. Some negotiations are now going on which might probably lead to a change altogether as regards that line, and they might be able to sell to a company apart from themselves the piece of line now idle, and upon which they were losing very heavily. It was an expensive piece of line, and had not been earning anything during the last six months. If it had been earning a proper return, it would have brought in a revenue probably equal to nearly 1 per cent. dividend. There was a proposal before Parliament for an independent company to make a line from the end of the Islington line to King's Cross and Euston. That would be a very valuable line to the public, and was likely to produce a very large traffic upon itself, and bring heavy traffic to the C. and S.L. city stations. They had thought it advisable to try to make arrangements with that line to work it, saving them the necessity for generating stations. They hoped to be able to work it at much less cost than the company itself could do with a small independent line of that kind. That arrangement had not yet been finally completed. If the Act went through, it would not involve the C. and S.L. in anything more than the working of the line for a percentage of the receipts, without any responsibility for its capital. After referring to the benefits of foot subways, the speaker said that the Baker Street and Waterloo Railway was going on rapidly with its construction, and they had purchased the Blind Asylum for their generating station. That line would connect the C. and S.L. with the very heart of the busy west end traffic. The Great Northern and City Railway Company were getting on fast. They were constructing a very expensive railway with 16-feet tunnels, and thought they would get a return for it; he hoped they would. After referring to the inter-connection of this with other railways, the chairman said that the C. and S.L. was a coming line of the greatest importance, and one of the most valuable railway links that could possibly exist in a great city like London. The arbitration about the St. Mary Woolnoth Church was making progress, and before long they would know the amount they had to pay. They had already a large amount deposited to draw from for that To provide for the capital for the Islington extension they issued 10,000 ordinary shares. They had to be issued at a low price, but they got premiums on certain other stocks. They proposed to apply to Parliament for a Bill to construct a foot subway between the Angel and the Agricultural Hall. That would help their traffic not only from the Hall itself, but would tap the very heavy traffic of the Upper Street. They were also seeking powers to provide in the future for certain payments in regard to the final completion of the Islington extension contracts. For the growing traffic also they wanted additional rolling stock, and improvements at the generating stations. These were included in the proposed Bill. Turning to the accounts, he said that they had during the half-year expended £97,645 on works, rolling stock, &c. The discount on the ordinary stock issue was £48,000. The speaker then analysed to some extent the receipts and expenditure, and he went on to say that they had run an increased mileage of 141,697 miles, and the number of trains had increased for the whole distances, 3,956. The number of passengers had increased (trains running longer distances) more than proportionally. They carried in each train 44·8 passengers in the last half of 1899, and 62·13 in the past half. They got very much more in and out traffic in consequence of the increased length of line. The receipts per train mile increased from 7s 2d. to 7s. 11d; receipts per train mile increased from 2s. 3·28d. to 2s 5·24d.; receipts per passenger were 1·91d. in 1899, and had risen to 2·23d. This was all very satisfactory. The working expenses were in 1899 58 per cent., and were now reduced to 56·22 per cent., which, considering the increased price of coal and materials, was an exceedingly satisfactory feature. It was the lowest rate in the history of the concern. If they deducted the cost of the lifts it was reduced to 48·80 per cent. for the line. The future would show that they would be able to reduce that very low rate considerably. The expenses per train mile increased from 1s. 3·84d. to 1s. 4·44d. The locomotive charges were decreased from 5·85d. to 5·50d., and the traffic expenses had increased from 6d. to 7⅓d. per train mile, but the latter would be decreased before long. He then moved the adoption of the report.

Mr. Grenfell seconded the motion.

After a number of questions had been put to the board and several criticisms of the proposal to lay the subway to the Agricultural Hall had been offered, the resolution was carried unanimously.

The questions contained reference to the possibilities of vibration troubles. The chairman said in this connection that heavy rolling stock might be suitable for the big traffic of the Central London, but he would rather have shorter and smaller trains. In busy times the C. and S.L. was running trains faster than the C.L.R. It had more trains per hour, and was running a 2½-minute service, but they intended running them very much more frequently than that. They were considering the number of carriages per train. Their platforms were made for longer trains, and they had it in contemplation to put four coaches on to the trains at certain times of the day. Every ton of rolling stock used unnecessarily meant a diminution of the profits. They had to bear in mind the weight of the trains. The weight of C. and S.L. trains was not more than the weight of the engine alone on the C.L.R., and they would thus understand the difference of weight being dealt with at the present moment. They would find in the end that their mode of working was most economical and best in the public interests. He did not say that they had arrived at a complete condition of things; they were always trying to improve, but in the main he thought that what they had adopted would be generally adopted. In regard to the question of vibration, they had had no complaints of vibration from any residents during the last 10 years. Their line did not produce it. Therefore, whether the Board of Trade put a clause in their Bill or not did not affect them. The matter had been greatly exaggerated in the case of the Central London, but they were carrying enormously heavy rolling stock and engines. If there was any vibration there, it was caused chiefly by the construction of the rolling stock and slightly by the construction of the permanent way. He thought it very doubtful whether any clause would be put in. Every railway in London would be affected, as every large railway was vibrating the houses on each side of it. The question of vibration was so important to the public that any attempt on the part of Parliament was fraught with such objection on the part of the public that it was not at all likely to be put in. In regard to the lifts, they were experimenting with a view to improvements. They were trying to get the same thing as on the Central London, but with less complication. One lift was now being worked, and he thought they had succeeded. They were going to change all the lifts as fast as they could.

The resolutions declaring dividends in accordance with the report, re-electing Mr. C. G. Mott as director, and re-electing the auditors were carried, and the meeting became special, and passed certain resolutions approving the Bill proposed to be applied for.

Kensington and Knightsbridge Electric Lighting Company.

The directors' report, to be presented at the fourteenth ordinary general meeting, to be held at 1, Great George Street, Westminster, on Wednesday, February 13th, at 5 p.m., reads as follows:—

"The directors submit to the shareholders a statement of the accounts of the company, together with a report of the position of the undertaking at the end of the year 1900. During the year the number of houses and shops connected with the system has increased from 2,110 on December 31st, 1899, to 2,324 on December 31st, 1900, while the number of lamps, calculated on the usual basis of 8 c.p., has increased from 183,462 to 199,098. The directors have strengthened the renewal account by transferring to it £7,594 10s. 9d., making the total amount placed to that account £37,974 10s. 4d. After providing for the above amount, and paying the dividends on the 6 per cent. first preference shares to June 30th, 1900, on the 5 per cent. second preference shares to September 30th, 1900, and an interim dividend at the rate of 12 per cent. per annum on the ordinary shares for the first half of the year, the balance standing to the credit of the net revenue account for the year 1900 is £11,006 12s. Of the above sum £1,425 has been appropriated to the payment of the first preference dividend to the end of the year, and £593 15s.

has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date, leaving £8,987 17s., out of which it is proposed to pay a further dividend on the ordinary shares of 6 per cent. for the past half-year, making, with the interim dividend paid on July 26th, 12 per cent. for the year. This will leave a balance of £4,712 17s. to be carried forward. The directors have to inform the shareholders that the issue of new ordinary capital has been fully subscribed by the shareholders, and the directors invite the shareholders to concur with them in the issue of shares to the staff as stated in the circular of January 1st. The directors have the pleasure to report that the new generating station, which has been constructed in conjunction with the Notting Hill Electric Lighting Company, Limited, was sufficiently advanced to enable the company to obtain material assistance from it towards the end of last year, and we believe that it will be fully available for regular supply early in the spring. The capital for this undertaking has been obtained by the issue of 4 per cent. debenture stock, guaranteed jointly and severally by the two companies. A transformer station has been equipped and is now in full working order on a site obtained from His Majesty's Commissioners for the Exhibition of 1851, at the back of the Royal Albert Hall; this will render the accumulator station in Queen's Terrace Mews unnecessary, and it will shortly be discontinued. The sum of £1,656 10s. received as premiums on the issue of second preference shares has been appropriated to the reduction of the purchase of the Kensington Court Company account, and the sum of £818 11s. 11d. received from Mr. Lane-Fox, in payment of the amount agreed by the directors to be taken in settlement of the company's claim for costs, has been transferred to the credit of the mains account. In accordance with the articles of association Mr. A. S. Bolton and Sir Frederick J. Bramwell, Bart., F.R.S., retire from the directorship, and, being eligible, offer themselves for re-election. The auditors, Messrs. Lovelock, H. W. S. Whiffin & Dickinson, having dissolved partnership, Mr. A. L. Dickinson, the remaining partner, having joined Messrs. Price, Waterhouse & Co., the latter firm were appointed by the directors to audit the present accounts. Messrs. Price, Waterhouse & Co. offer themselves for re-election."

Anglo-American Telegraph Company.

The ordinary general meeting of the proprietors of this company was held on Friday last at Winchester House, Old Broad Street, Mr. F. A. Bevan presiding.

The Chairman said that before proceeding to the usual business he was sure he would be expressing the feelings of all present, as well as of the many absent shareholders numbering some 7,000, in expressing the sense they felt of the deep loss that had been sustained by the country through the death of our beloved Queen, and at the same time to express to His Majesty King Edward VII. their loyalty and devotion to his person. Passing to the report and accounts, Mr. Bevan said he would not detain the shareholders long in proposing their adoption. They were none of them surprised that the directors were not able to present as large a profit as last year. They had always told them that when the German cable was in working order it would take away from them a certain amount of their traffic, and so it had proved. The German cable from the Azores began working on September 1st. Before that they had lost some portion, but not much, of the traffic which had been sent by Germany over the Commercial Cable; but from September 1st they practically lost the traffic, and the result was that their receipts for the half-year were rather more than £16,000 less than they were for the last half-year. But it was not only owing to the loss of their German traffic that their receipts for the half-year and for the whole year came out worse than they did in 1899, but it was even more owing to the fact that the *Minia* had not been so much employed in effecting repairs for their friends. Looking at the whole year their traffic receipts were less than in 1899 by £15,200 and working expenses had increased by £2,961. The earnings of the *Minia* were less by £20,760, so that the greater part of the diminution in their revenue arose not from traffic receipts, but from the earnings of the *Minia* being so much less. Of course that was a matter which no one could prevent, and he had always told them that those earnings were not a dependable source of income. Not only did they not receive so much from the earnings of the *Minia*, but they had to spend a good deal more on the ship. The net result was that there was £38,920 less available for dividend than they had last year, and the dividend for the half-year would be at the rate of 32s. 6d. as against 43s. 6d. Under all the circumstances he thought that was a very satisfactory result. The renewal fund had been increased during the year by £28,055. As to this present half-year he did not like to prophesy, but he might say this—that they had begun the year very well. They estimated that they might lose by the German traffic something like £200 a day, whereas, as a matter of fact, during January, their traffic had only been about £70 a day less than it was in January of last year. Therefore it appeared to him that they were already making up for the serious loss which they could not help sustaining from the opening of the German Cable Company. As to the deferred stockholders, he could not promise them anything next half-year, but he hoped they might get a dividend. In conclusion, the chairman alluded with satisfaction to the excellent services of Mr. J. H. Carson, the general manager of the company, and the staff.

Sir Gerald Fitzgerald, K.C.M.G., seconded the motion, which was adopted.

The retiring directors and auditors having been re-elected, the proceedings terminated with a vote of thanks to the chairman for presiding.

Scarborough Electric Supply Company.

The annual report of the directors of the above company states:—The following figures show the present position and progress of the company, viz.:—

	December 31st, 1900.	December 31st, 1899.
Consumers	592	465
Equivalent 8-c.p. lamps connected	33,343	27,171
Board of Trade units supplied	331,266	257,412
Total revenue	£7,788 4s. 0½d.	£6,235 12s. 11½d.

The accounts show that the balance to be disposed of is £3,721 2s. 5d., which the directors recommend should be dealt with as follows:—Placed to depreciation account, £529 18s. 1d.; dividend at 6½ per cent. per annum, £3,088 10s. 6d.; carried forward to 1901, £102 13s. 11d. The capital expenditure stands at £53,193 17s. 9d., being an increase of £9,120 10s. 2d. during the year. The outlay has been mainly incurred in enlargement of buildings, and additions to the plant at the generating station. The 5,000 additional shares mentioned in the last report have been created. Of these 1,000 have been issued, and £6 per share had been called up thereon up to December 1st, 1900. Further capital will, of course, be required from time to time, as the operations of the company extend. The retiring directors are Mr. John Bell Simpson, Mr. J. W. Woodall, and Mr. John Dale, who again offer themselves for re-election. The auditors, Messrs. Bradley, Davis & Co., chartered accountants, also offer themselves for re-election.

Amazon Telegraph Company, Limited.

Mr. W. S. Andrews presided, on Wednesday, over the sixth ordinary general meeting of the shareholders of the above company, when the report and accounts was adopted. The report reads:—

The directors submit their report and the accounts of the company for the year ending June 18th, 1900. The revenue amounts to £14,427 17s. 4d., and the expenses to £39,996 15s. 5d. After adding £8,900 for debenture interest and sinking fund, there is a debit balance of £34,468 18s. 1d., which, added to the debit balance of £29,300 8s. 2d. brought forward from the last account, leaves £63,769 1s. 3d. to be carried forward. The traffic receipts show a substantial increase as against last year, but there is a considerable reduction in the Government subsidy on account of interruptions. This arises from the fact that for a portion of the year to June 30th, 1899, the subsidy was paid in full. Towards the end of the year 1899, the directors were fortunate to secure the services of Captain W. H. Lacy, a gentleman having a long experience in cable work. He proceeded to the Amazon, and took charge of the ss. *Viking*, during the absence of her commander through ill health. Captain Lacy energetically set to work to repair the cables, with the result that through communication between Para and Manaos was re-established in April last. There have been several interruptions since, but, on the whole, an improvement has been achieved, and many difficulties overcome, so that the directors are led to hope for a better service in the future. Considerable progress has been made with the erection of the land line referred to in the last report, and at this date the sections between Manaos and Itacoatiara are working. Arrangements are being made for raising further capital for the purpose of completing the land line, purchase or construction of a steamer adapted for cable repairing on the river Amazon, paying off temporary loans, and providing working capital. This may involve a partial reconstruction of the board. The present directors will render every assistance required to enable the necessary measures to be carried. An extraordinary general meeting will be held immediately after the ordinary meeting, for the purpose of sanctioning the issue of £150,000 debentures, ranking in priority to the existing debentures. The retiring directors are Mr. D. H. Goodsall and Mr. George Keith, who offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire at this meeting.

Subsequently a resolution was adopted authorising the directors to create and issue from time to time debentures for an amount not exceeding £150,000, bearing interest at a rate not exceeding 6 per cent., such debentures to rank in all respects in priority to the existing issue of £200,000.

Great Northern & City Railway Company.

The fifth half-yearly general meeting of the proprietors of this company was held on Friday last at Westminster Palace Hotel, Sir Charles Scotter, J.P., in the chair.

The Chairman, before proposing the adoption of the report, alluded with regret to the death of the Queen, and said that in her death we mourned the loss of the best, the wisest, the most beloved and the most gracious Queen that ever reigned either in this or any other country. Passing to the business of the company, he said that he dare say many of the shareholders had read in the newspapers an account of an action which the Great Northern Railway Company had brought against them. The verdict in the first Court was in favour of the Great Northern Railway, but they (the Great Northern & City) had appealed, and the case was therefore now *sub judice*. All he would say was, that even if the higher Courts upheld the verdict already given, he did not think the shareholders would be affected in any way whatever. He was glad to tell them that within the last few days his colleagues and himself had visited the railway and the works in connection with it, and they were all exceedingly pleased, not only with the progress of the works, but especially with the admirable and substantial manner in which the works were being carried out by Messrs. Pearson, the contractors. At the present time 2½ miles of tunnel had been completed, and at the rate of progress which was now going on the contractors assured them that over a quarter of a mile of tunnel would be completed every month, so that, on the whole, the progress being made was exceedingly satisfactory. Having explained how the work was being done by the specially-designed shields, Sir Charles said that what struck them most particularly on the occasion of their visit was the size of the tunnels. He was connected with the Waterloo and City Railway, and there the tunnels compared with those on

the Great Northern and City Railway were exceedingly small. Of course the larger tunnels had considerably added to the cost, but the advantages to be derived therefrom were only just now being appreciated, and he thought it would be found that one of the wisest things in connection with that railway had been the making of those large tunnels. First of all, they would admit the largest rolling stock built in this country, and would enable carriages with side doors to be used, and that could not be done on any of the electric railways now in use. With those large tunnels they would be able to adopt any form of electrical power that was at present known, and if thought proper they would be able to use what was known as the multiple unit system. Up to the present time we had always assumed that the best form of electrical traction was to be found in America, and he believed we were right, but it seemed that now the time had arrived when America was going to be eclipsed by the invention of an electrician in Buda-Pesth. He (the speaker) was told on the highest authority in this country that the whole system of electrical traction was going to be revolutionised by it, but he was afraid the system could not be applied to small tunnels. They would thus see what an enormous advantage they would have in having those large tunnels. He was also told that the cost of the system was 40 to 45 per cent. less than the cost of any existing known system in use in this country, and the working expenses would also be enormously reduced. It looked, therefore, as if they had exercised a very wise discretion in delaying until the very last moment making arrangement for the electrical equipment of the railway. Then, again, the motors would work directly upon the wheels of the carriages, and consequently the use of heavy locomotives would be avoided. They knew that there was a controversy going on in connection with the Central London Railway, and vibration which was said to be due to the heavy locomotives. Besides that, the wear and tear of the permanent way was enormously increased by heavy locomotives, and, therefore, they would be able to save enormously in that respect. Another advantage of their larger tunnels was that the current of air was largely increased. He had come to the conclusion that some day or another those (himself amongst the number) who were instrumental in projecting these electrical railways would regret that they made the tunnels too small. Another thing in connection with the tunnels, which struck him and his colleagues, was the length of the platforms. They were 420 feet long, and they would be able to accommodate a train carrying from 600 to 700 people. That would be of immense advantage in dealing with the heavy morning and evening traffic, which was the traffic which would pay their dividends. Another novelty in the construction of the tunnels, which they considered a great improvement upon existing tunnels, was the substitution of brickwork in cement for the lower half of the tunnels. They were told that the construction of the tunnels in that form would—he would not say absolutely do away with vibration, but, at any rate, reduce it to a minimum, so that whatever complaints there may have been on other railways on account of vibration would not apply in their case. In conclusion, he proposed the adoption of the report and accounts.

The Earl of Lauderdale seconded the resolution, which was carried.

Crompton & Co., Limited.

Mr. Trotter (chairman), presided on Wednesday at the Cannon Street Hotel over an extraordinary general meeting of the shareholders of Crompton & Co., Limited, held for the purpose of considering, and if approved, of passing the following resolution:—"That the capital of the company be increased to £300,000 by the issue of 46,000 new shares of £3 each, such shares to be numbered 54,001 to 100,000 inclusive, and to rank in all respects *pari passu* with the existing shares of the company, and the directors are hereby authorised to issue these new shares at such times and on such terms as they may think fit."

The Chairman said that when they met in August last, a shareholder asked if they intended raising more capital, and at that time he stated that they had no idea of doing so, but it had now been forced upon them. They had of late years gone on conservative lines, desiring rather to be under-equipped for a possible business than over-equipped, because they had always had present to their minds the danger of a slack time for electrical engineering coming and finding them with a large number of men, and large works, and a large capital sunk in those works on which it might be difficult to earn dividends. But the course of electrical engineering had to a great extent changed recently, and they found that the effect of the latest development at the works which was intended to enable them to carry out the business they had in hand, had the further effect of vastly increasing the number of their orders. Consequently they found themselves at the present time quite unable to meet the business offered to them. Everyone must have seen what a lot of notice was being directed to electrical matters in the past few months, and the result was that they had before them an amount of business which it would be perfectly impossible for them to carry through with their present equipment. In the interests of the shareholders, they had to provide for what was before them. Large factories were being established in the country for producing electrical machinery, and they must be prepared to compete with them. Otherwise they must be prepared to take a second place and sink into the background. Electrical appliances were becoming very large, and took a long time to produce, and they had now orders on their books for delivery in July of 1902. That involved a large amount of money in working capital. They had practically no stock because constant changes took place in electrical machinery, and it was not desirable to hold large stocks which might become obsolete at any moment. They would probably not want all the money they asked for, but thought it as well to take the powers at once. He concluded by moving the resolution.

Mr. C. F. Tufnell seconded the motion.

Replying to questions, the Chairman said they would issue the capital when the right time came, but they had not settled the question of price, although they would not probably seek for a high premium. Shareholders would be considered, but they did not intend to confine the issue to shareholders.

The resolution was carried.

South Lancashire Electric Traction and Power Company.

The first ordinary general meeting of this company took place at the Law Association Rooms, Liverpool, on Monday. Sir J. A. Willox, M.P., chairman of directors, presided.

Speaking of the position of the company, the Chairman said that the prospectus was issued in December last, when debentures and preference shares were offered for subscription. £500,000 of debenture stock was allotted, of which £111,992 had been received in cash. Of the preference shares, 51,132 were allotted and issued, in respect of which the payments made amounted to £11,360. The preliminary work of the company was well in hand. An efficient staff of engineers had been appointed, and were busy on a detailed survey of the routes and in preparing plans and specifications. In a short time the directors would be in a position to invite tenders for the construction and equipment of the line. The first section to be put in hand would be the line from Prescot to Liverpool, by which St. Helens would be connected with Liverpool by electric tramways. The generating station would be at Leigh, and would be equipped with plant sufficient to work the whole system, which covered 35 miles of track. The company were prepared to provide travelling facilities for the teeming populations of the district, and looked with confidence to the local authorities to assist in realising their hopes. The public no less than the shareholders might feel assured that no time would be wasted in bringing the electric tramways into operation.

Replying to a question, the Chairman stated that 51,000 was the total number of preference shares allotted, and that the 6 per cent. interest would accrue as the calls were paid up, but would only be payable out of the profits of the company.

Blackpool and Fleetwood Tramroad Company.

The report of the directors for the half-year ended December 31st, to be submitted to the meeting to be held at Manchester on 19th inst., states that including the sum brought forward, the balance of profit, after providing for debenture interest, is £10,687, and the directors recommend a dividend at the rate of 9 per cent. per annum, which will absorb £6,750, writing off £1,000 to depreciation and reserve, and £1,100 for preliminary expenses, leaving £1,837 to be carried to the current half-year. The number of passengers carried during the half-year was 1,171,525. The receipts from all sources amounted to £21,130.

Wigan and District Tramways Company.

The report of the directors states that for the last year there was a net profit of £4,130 19s. 10d., to which was added the sum of £121 12s. 7d. brought forward from the previous year, making a total of £4,252 12s. 5d. available for dividend and other purposes. An interim dividend, at the rate of 7 per cent. per annum, was declared for the half-year ended July 31st last, and there now remained a balance of £2,965 2s. 11d. A dividend at the rate of 7 per cent. per annum (free of tax) for the six months ended December 31st, is to be paid.

National Telephone Company, Limited. — The directors have resolved, subject to final audit, to recommend at the forthcoming general meeting the following dividends for the half-year ending December 31st last:—At the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares; at the rate of 5 per cent. per annum, less income-tax, on the third preference shares; at the rate of 5 per cent. per annum, less income-tax, on the ordinary shares, carrying £85,000 to reserve and about £6,000 forward. The transfer books will be closed from February 8th to 21st, both days inclusive, and the dividend warrants will be posted on the latter date.

Stock Exchange Notices.—Applications have been made to the committee to appoint a special settling day in and to grant a quotation to:—Electric and General Investment Company, Limited, 19,900 6 per cent. cumulative preference shares of £5 each, fully paid; and to allow the following securities to be quoted in the official list:—Cape Electric Tramways, Limited, 400,000 shares of £1 each, fully paid, £140,000 5 per cent. mortgage debentures, and £315,000 6 per cent. mortgage debentures; City and South London Railway Company, 10,000 shares of £10 each, fully paid. The committee have appointed special settling day as under:—Wednesday, February 13th. Metropolitan Electric Supply Company, Limited, further issue of 13,769 ordinary shares of £10 each, £5 paid, Nos. 85,001 to 98,769; and have ordered same to be officially quoted.

Waterloo and City Railway Company.—The report for the half-year ended December 31st states that the gr ss receipts, less Government duty, amounted to £15,482; the London and South-Western Company has retained £6,590 in respect of working expenses, leaving £8,892 payable by it in order to provide for a dividend at the rate of 3 per cent. per annum on the company's ordinary and borrowed capital. The number of passengers carried during the past six months, exclusive of season ticket holders, was 2,038,400, showing an increase of 268,669, and the season ticket holders on December 31st numbered 883, as against 776 at the end of December, 1899.

The Electric Lighting and Traction Company, of Australia, Limited.—Since the annual meeting was held on January 7th, cabled advices have been received from the company's manager in Australia, stating that the purchase of the two Melbourne undertakings has been completed; the company is, therefore, now in full possession of these properties and their revenues.

Telegraph Construction and Maintenance Company. The directors propose paying a dividend of 10 per cent (£1 4s. per share), together with a bonus of 2½ per cent. (6s. per share), in addition to the 5 per cent. already paid, making 17½ per cent. for the year 1900.

British Electric Transformer Manufacturing Company.—The directors have decided to pay an interim dividend for the half-year ended December 31st at the rate of 10 per cent. per annum, less tax.

New Zealand Electric Light and Traction Company.—The directors have declared a dividend of 60 per cent. for the year 1900.

City Matters.—Owing to the abundance of financial matter current this week, and to the pressure upon our space, we are compelled to hold over a number of reports of electricity supply companies, &c., until our next issue.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending January 25th were £402 12s. 7d.; corresponding week last year, £385 12s. 8d.; this year's increase, £14 0s. 4d. Total to date, £1,468 14s. 8d; corresponding period last year, £1,3 9 0s. 1d.; 25 days' increase, £144 11s. 7d. Miles open, 8½. Week ending February 1st, £420 11s. 8d.; corresponding week last year, £339 14s. 4d.; increase, £80 17s. 4d. Total to date, £1,884 3s. 4d.; corresponding period last year, £1,063 11s. 10d.; increase, £22:0 11s. 6d. Miles open, 8½.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending February 2nd were £142; corres onding week last year £167; decrease, £25. Total to date, £671; corresponding period last year, £740; decrease, £76.

Bristol Tramways and Carriage Company.—The receipts for the week ending February 1st were £3 612 6s. 0d.; corresponding period last year, £2,476 3s. 10d.; increase, £1,136 2s. 2d.

Central London Railway.—The receipts for the week ending February 2nd were £7,112; previous week, £5,961; decrease, £1,115. Total receipts to date (5 weeks), £30,578. Miles open, 6.

City and South London Railway.—The receipts for the week ending February 3 d were £1,955; corresponding week last year, £1,119; increase, £836. Total to date, £9,978; corresponding period last year, £5,590; increase, £1,388. Miles open, 1901, 4½; 1900, 3½.

Dover Corporation Tramways.—The receipts for the week ending February 2nd were £139 17s. 0½d.; corresponding week last year, £149 16s. 2d.; decrease, £9 19s. 1½d. Total to date, £775 1s. 11d.; corresponding period last year, £756 5s. 2d.; increase, £18 16s. 9d. Miles of track open, 3. Car miles run, 1901, 4,595; 1900, 4,205. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending February 1st were as follows:—D. U. T. Co., electric cars, £3,109 3s. 8d.; ditto, horse cars, ——; D. S. D. Co., electric cars, £612 11s. 6d.; total £3 721 1 s. 2d.; corresponding week last year—D. U. T. Co., electric cars, £2,789 2s. 11d.; ditto, horse cars, £81 16s. 6d.; D. S. D. Co., electric cars, £569 12s. 2d.; total, £3,440 11s. 7d.; increase, £281 3s. 7d.; aggregate to date, £17,834 14s 6d.; aggregate to date last year, £16,081 1s. 1d.; increase, £1,753 13s. 5d. The mileage worked is 45 miles electrically, — miles by horses, as against 38 miles electrically, 6 miles by horses, for the corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending February 3rd were £1,404; corresponding week last year, £1,527; decrease, £123. Total to date, £7,398; corresponding period last year, £7,553; decrease, £155 Miles open, 6 miles 57 chains. 1900 includes day of embarkation of Yeomanry, &c., for South Africa.

STOCKS AND SHARES.

Wednesday Evening.

THE time of dividends is always attended with somewhat nervous markets, and more particularly if there is a likelihood of the announcements being of an unsatisfactory character. In common with other investment departments of the Stock Exchange, the electrical sections are irregular, dividend forecasts alternating between good and bad in various classes of securities. For instance, the electrical supply market had been expecting distributions at the same rate as those made this time last year, and the impression was strengthened by the declaration of the St. James's dividend, which carried out the market's prophecy to the letter. But quickly on the heels of this followed the Westminster Company's declension of 2½ per cent. in its dividend rate, and in consequence of this latter announcement the general tone has been inclined to heaviness this week. Westminsters themselves are naturally flat, and City of London are also in evil case on fears that no dividend will be paid this half-year. The only hardening in the supply department has occurred in the prices of Edmundson's 4½ per cent. Debenture stock and Notting Hill shares, which are both a fraction higher on the week. Kensingtons, despite their good dividend of 12 per cent. for the year, are about the same. For 1899 the rate was 11 per cent., and for 1898 it was 10 per cent.

In the telegraph market a fair amount of activity is apparent, chief interest falling to Anglo-American stocks. Both Ordinary and Preferred show an advance of 2 per cent., and the "A" stock is 10s. to the good. "It is not improbable that some slight reaction," we wrote last week, "may now take place after the heavy drop of the past fortnight." Eastern Ordinary is also two points up, the stock being fully worth the price as an investment. Eastern Extension new shares are now fully paid, and are quoted at 14, as against 14¼ for the senior issue. Eastern stock and "China" shares are now relatively the same price, and the rise in the former was helped by the opening of the new line by the Eastern Company the other day. Several of the telegraph stocks and shares were quoted *ex* dividend on the last settling day, January 31st, both the Globe emissions, for example. Globe Ordinary are 3s. 3d. per share down, allowing for deduction of the dividend, but the Preference, unchanged at 15¼ *ex* dividend, are really up 3s. a share.

The Amazon Telegraph report is too gruesome to dwell upon here. It will be found in another column, and it is only in the natural order of things, that the price of the Debentures should have tumbled a further 10 points. Even at 70 we doubt whether there are any buyers to be found. Another announcement which has caused disappointment is that of the National Telephone Company, telling of a fall in the dividend from the 6 per cent. of a year ago to 5 per cent. to be paid now. The Ordinary shares are down 5s. on the declaration, but there is no change in the Preference issues, the interest on which is, of course, pretty well secured.

Upon the digestion of the proposal to convert Central London Railway shares into stocks, the market put down the prices of the undivided and the Deferred. The suggestion is decidedly unpopular, and it is difficult to see what object the directors can have in wishing to make the alteration. At present there is a comparatively free market in "Twopenny Tube" shares, but it is sure to become more limited if the suggestion of converting into stock is generally adopted. But no doubt more detailed information as to the board's idea will be submitted to the meeting next Wednesday. By the way, a slip of the pen made us allude to the meeting of the City and South London Railway last week; of course, we meant to say the company's report.

Shareholders in the Telegraph Construction and Maintenance are to enjoy a very practical proof of the company's expansion in the shape of a bonus of 2½ per cent. With this the dividend will be raised to 17½ per cent. for the whole year; for 1899 it was 15 per cent. The price of the shares quickly responded to the change. It is hoped that Henley's will also be able to make a better showing than usual, and a good bonus is already anticipated in the Stock Exchange. Fifteen years ago Henley's were as favourable a gambling counter as any Kaffir share is now, but long since the speculation died out and the shares are steadily resting on an investment basis. Electric Constructions, quoted *ex* the dividend of 1s. 9¾d., are unaltered, but Crompton Preference weakened on deduction of the 1s. 9d. per share, the coming issue also tending to depress the price. Callender's Preference are the turn easier.

The Rand Central Electric Company, which lately suffered damage to the extent of £4,000 from a Boer commando, is under the protection of the South African market, and the shares remain at $\frac{7}{16}$. Another far-away concern is the British Columbia Electric Railway, in the report of which, just issued, we are told that "it is now raining," and the manager trusts it will continue to. After a snowfall for over a week at the rate of ½ an inch per diem, the manager's hope is not surprising. Paris was "Tubele-s" for three days on account of a strike on the Metropolitan (electric) Railway in that city, but the differences have been compromised, and the men are back at work. The reckless gambling in electric traction shares that was in progress some weeks ago on the Paris Bourse has now quieted down. No doubt the French public by this time are regretting their folly.

Six per cent. is not exactly a brilliant achievement for the Dublin United Tramways' first year of electric working, and the price of the shares has fallen heavily. The optimists who were forecasting 20 per cent. must be feeling rather out of it. In the metropolis the London United Tramways Company are at length on the point of starting publicly their service of electrical cars. The price of the new issue of Debentures is 2 to 4 premium.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations Jan. 30th.	Closing Quotation Feb. 6th.	Business done during week ended Feb. 6th, 1901. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	...	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	75 — 85	65 — 75	...	...
822,700	Anglo-American Telegraph	Stock	£3 9s.	73/6	3⅛%	51 — 54	53 — 56	54	...
3,088,540	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	96 — 98	98 —100	100	98
3,088,540	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	8¼— 8⅝	8⅝— 9⅛	9 5/16	8⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3 — 3⅛	3 — 3⅛	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	170 —180	170 —180	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103	102½
16,000	Cuba Telegraph	10	8 %	7 %	...	7⅛— 8⅛	8 — 9	8	...
6,000	Do. 10 % Pref.	10	10 %	...	...	16 — 17	16 — 17	16⅜	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100-104%	100 —104%	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	10 — 10½	10 — 10½	10¼	10 1/16
108,300	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	138 —143	140 —145	144½	138½
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	95 — 98	95 — 98	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	109 —113	109 —113	...	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	...	14 — 14½	14 — 14½	14 7/16	14⅛
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.)	10	...	...	...	11⅞— 12⅛	13⅜— 14⅛	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	112 —117	110 —115 xd	112⅜	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	101 —104	99 —102 xd	101	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5⅛%	...	10⅛— 10⅜	10 — 10⅛xd	10⅜	10 1/16
180,042	Do. do. 6 % Pref.	10	6 %	...	...	15 — 15½	15 — 15⅛xd	15 5/16	15
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	...	32 — 34	32 — 34	...	...
82,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	47 — 51	47 — 51	49½	47⅜
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	104 —107	104 —107	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	2½%	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝— 1	⅝— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	4¼— 4⅜	4 — 4⅛	4⅛	4 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	12	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5	4⅞
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 — 97	94 — 97	...	...
500,000	Do. 4 % Deb. Stock Red.	100	...	...	4 %	97 —100	97 —100	99½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	99½	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129	124 —129	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4⅜— 5⅛	4⅜— 5⅛	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
23,361	Do. do. Nos. 16,640 to 40,000 £3½ pd.	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs.	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Brzn. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14 — 14½	14 — 14½	14⅜	14 1/16
75,000	Do do. 5 % Debs. 2nd series, 1906	100	...	...	...	101 —104	101 —104	...	...
348,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	⅝— ¾	⅝— ¾	¾	⅝
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	6 — 7	6 — 7	6⅜	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	...	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	...	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	5⅝	5⅝
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	...	6½— 7	6½— 7	6⅞	...
150,000	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	6 %	4 %	...	8½— 9⅛	7½— 8½	8	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	...	...	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	125½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	...	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	...	...	11½— 12½	11½— 12½	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	106 —109	106 —109	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	7 %	...	...	4½— 5	4½— 5	4 5/16	4¼
75,000	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	102 —104	102 —105	104	103⅜
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1½— 2	1½— 2	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	98 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	...	12 — 13	12 — 13	12⅜	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	...	...
250,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	98½	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	...	14½— 15½	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½ %	14½— 15½	14½— 15½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	2 1/16	2⅜
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	13 %	10½ %	12½— 13½	12 — 13	12⅜	12¼

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked † are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Jan. 30th.	Closing Quotation Feb. 6th.	Business done week ended Feb. 6th, 1901. Highest	Lowest
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	8 — 9	8 — 9	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	...	...
45,000	British Electric Traction	10	6 %	...	...	13 — 14	13½ — 14½	13 11/16	13 11/16
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	...	...
350,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	121⅞	121½
85,000£	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅛ — ¼	⅛ — ¼	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	⅞ — 1	⅞ — 1	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	95 — 97	...	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	...	10½ — 11½	10½ — 11½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅞ — 6¼	5⅞ — 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	1⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2 1/16	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	105 —110	105 —110	...	...
108,710	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —103	101 —103	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	13 — 14	13 — 14	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¼ — 6	5¼ — 5⅜	5 1/16	5⅛
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	8½ — 9	8½ — 8⅝	...	...
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	...	...
78,703	Do. do. Def. do.	5	...	...	...	3½ — 4	3¼ — 3⅜	3⅜	3½
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	50 — 54	50 — 54	50½	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000 ...	10	...	...	...	4½ — 5½	4½ — 5½	4½	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½ — 4	3½ — 3¾	3½	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1⅞ — 2¼	1⅞ — 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	3½ — 4½	3½ — 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	88 — 90	88 — 90	...	...
100,000	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	96 —100	96 —100	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅞ — 2⅛	1⅞ — 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	....	...	...	101 —104 xd	101 —104	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	...	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	...	13½ — 14½	13½ — 14½	14½	14⅜
30,000	Do. do. do. 4½ % Pref.	5	7 %	...	...	5½ — 6	5½ — 6	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	21¼	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3⅜%	...	8⅜ — 8½	8⅜ — 8½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 ...	...	13¼ — 13½	13¼ — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	38 — 42	39 — 43	41½	41⅝
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	... %	...	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	...	10 — 11	10 — 11	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5¼ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	94 — 97	94 — 97	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 101—104.
Consolidated Telephone Construction and Maintenance, 3/—4/-
National Electric Free Wiring, 12/6 paid, ⅞—1⅛.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15¼—16½.
Do. do. Pref. (£10 pd.), 10—10½.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 11—12; 1st Preference Cumulative 6 % £5 (fully paid), 6½—7. Debentures, 101—104. Dividend, 1900, on Ordinary Shares 12 %.
*T. Parker, £10 (fully paid), 16.

Bank rate of discount 5 per cent. (January 3rd, 1901).

MARKET QUOTATIONS, Wednesday, February 6th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%).. ..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5s.	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to £145	£80 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¼d.	8d.	¼d. inc.
c ,, Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£86	£86	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£86	..
g ,, Rod	per ton	£86	£86	..
e ,, (Electrolytic) Bars ..	per ton	£82	£82	..
e ,, ,, Sheets ..	per ton	£90	£90	..
e ,, ,, Rod ..	per ton	£84	£84	..
e ,, ,, H.C. Wire	per lb.	9½d.	9½d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lbs	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/8	3/7	1d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	47/6	47/-	6d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10 5	£10 5	..
g Lead, English Ingot	per ton	£15 10 to £15 12 6	£16	10s. dec.
g ,, ,, Sheet	per ton	£17 15	£19	25s. dec.
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£126 10 to £127 10	£125 to £126	30s. inc.
g ,, foil	per lb.	1/6	2/-	6d. dec.
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9½d.	9½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4¾d.	4¾d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne ord.)	per ton	£21 12 6	£23 2 6	30s. dec.

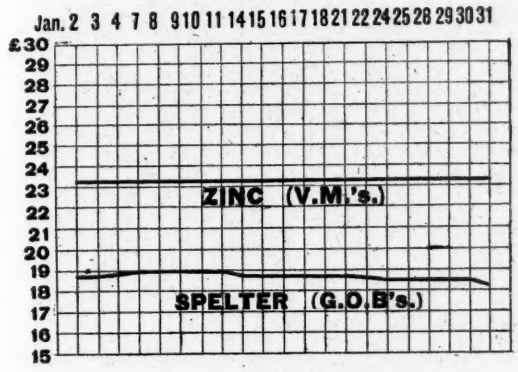
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yee & Co.

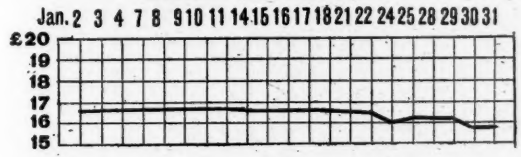
Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

METAL MARKET.

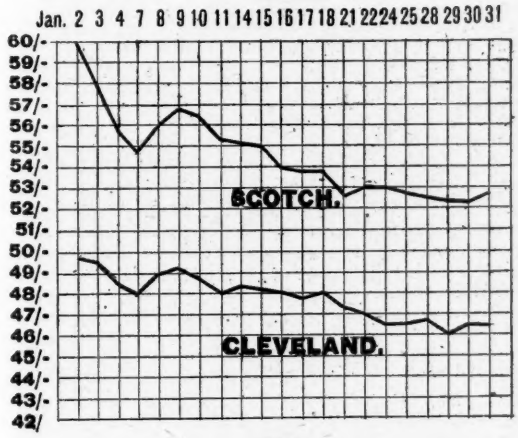
Fluctuations in January.



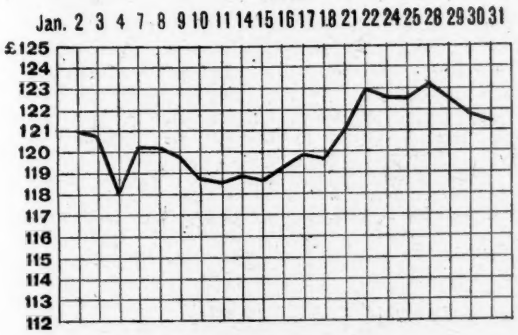
LEAD (ENGLISH).



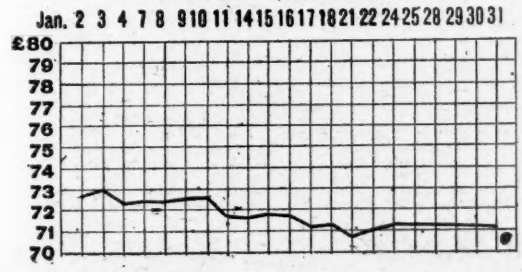
IRON.



TIN.



COPPER (G.M.B's.)



INSTITUTION OF ELECTRICAL ENGINEERS.

CAPACITY IN ALTERNATE CURRENT WORKING.

By W. M. Mordey, Member of Council.

(*Paper read January 10th*, 1901.)

(*Concluded from page* 214.)

An Alternate-current Wattmeter.

In concluding this paper I wish to describe an alternate-current wattmeter especially suitable for measurements such as are required in connection with the subjects treated in this paper. In devising this instrument my aim was to get a simple, strong, reliable wattmeter—one that needed no resistance added in its E.M.F. circuit, and that would absorb very little energy in that circuit even for large E.M.Fs. In such an instrument the E.M.F. coil should have a large force, and at the same time be practically without self-induction, and should be correct with all power-factors met with in practice. If possible it should be correct through a considerable range of periodicity.

Long and satisfactory experience of the Siemens dynamometer under workshop conditions made me turn to it as the most suitable type of instrument, and to try to devise means by which it should have the qualities just enumerated.

Fig. 7 shows the instrument in elevation and plan. Fig. 8 is from a photograph of an actual instrument.

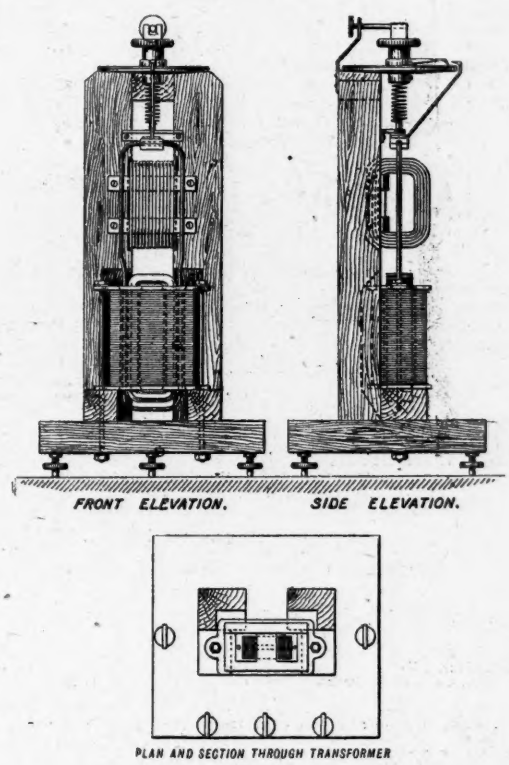


Fig. 7.

The Siemens dynamometer form is closely followed. The series or current coil is placed in the ordinary position. Under this coil is a small transformer, the primary winding of which is wound for any required E.M.F. Next to this primary winding a space is left at each side—the space usually occupied in a transformer by the secondary winding. In this space a closed coil of one turn of wire is suspended freely—the wire is platinoid, manganin, or some other conductor having a negligible temperature coefficient. This conductor is suspended and controlled exactly like the suspended coil of a Siemens dynamometer. It acts as the secondary of the transformer. As it is closed on itself no mercury cups are needed. Its circuit external to the transformer consists simply of a loop passing up the front and down the back of the fixed or current coil.

The action will now be understood. A comparatively large current of very low pressure is generated in the secondary coil. This current is in opposite phase to the E.M.F. It passes through the field of the fixed or current coil. The suspended conductor is acted on and deflected by the current in that coil, and is brought back to zero by the tension of the spring as in an ordinary dynamometer.

It will be seen that so long as the iron of the transformer is not forced to too high a density by using too great an E.M.F. or too low a periodicity, the secondary current will be proportional to the E.M.F. and independent of the periodicity. The magnetising

component of the primary current and the energy spent in the iron will vary with the E.M.F. and periodicity, but if the self-induction of the secondary coil is sufficiently low this will not affect the proportionality of the secondary current to the primary E.M.F.

The instrument shown on the table is the first I have had made. It has been kindly constructed to my drawings by Messrs. Siemens. By tests made at the Board of Trade electrical laboratory (in connection with which I have to thank Mr. Trotter and Mr. Rennie), I

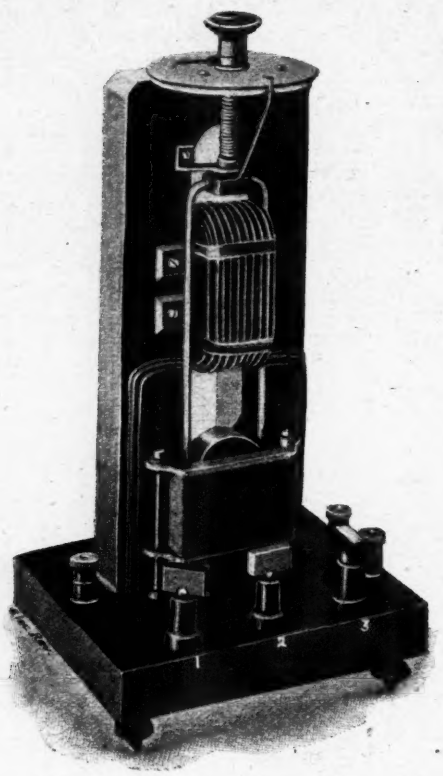


Fig. 8.

find my anticipations have been verified—the instrument has the same constant with power-factors of 1 and of 0·1, and it is proportional all round the scale.

This kind of instrument may easily be made for a large range both of E.M.F. and current, as the primary of the transformer as well as the current coils may be variously wound or connected—the suspended secondary conductor being always the same.

In the instrument exhibited the current coils are three in number, of varying section—the transformer primary being suitable for any E.M.F. up to 500 volts at 100 ~. The range is as follows:

Fine coil, for maximum of about			2·5	amp., constant		1·25	watts per division.	
Medium	"	"	"	15	"	"	6·8	"	"
Thick	"	"	"	90	"	"	37	"	"

This is at 83 ~. There are 400 divisions in the circle.

I have not succeeded, in this first attempt, in making the instrument independent of periodicity. The variation is about 10 per cent. between 30 ~ and 90 ~. In using the instrument it is therefore necessary to know the periodicity. I hope to greatly reduce this variation, or perhaps get rid of it altogether through a sufficient range for practical purposes. Even as it is, it will perhaps not be considered a very serious objection.

The principle of this instrument may be readily applied to other forms, but it would be premature to describe them here.*

In this paper I have not attempted to treat of several aspects of "capacity in alternate current working"—matters, perhaps, as important as those I have tried to make clear. I have avoided comparisons between different kinds of cables. I have considered single-phase only—not two or three-phase. I have said nothing of effects of capacity on regulation, on distribution of potential along lines, on liability to rupture of insulation due to capacity or on means for reducing such liability. In keeping to one aspect of the subject I have hoped to be of most use to my fellow electrical engineers.

I have to express my thanks, for information or facilities afforded me, to Mr. Gray and the Silvertown Company, to Mr. Edmunds and Mr. Howard, of Messrs. Glover & Co., to Mr. Nisbett and the British Insulated Wire Company, and to Mr. Gavey (chief engineer of the Post Office). Also to Mr. Dallas and Mr. Grafton, respectively of the Silvertown and the County Companies, for assistance in experiments. I have already mentioned my indebtedness to Mr. Sparks and the County of London and Brush Provincial Company.

* I should mention that some years ago Mr. Swinburne proposed or made an instrument in which he pivoted a closed-circuit conductor; this had a current induced in it and was deflected by the flux in an air-gap in which it hung.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

No. 39.

"Power Plant" writes:—"I would feel very much obliged if you could vouchsafe me the following information:—

"A waterfall is situated 1½ miles from a manufacturing township. The manufacturers wish to generate electric power and transmit the same in order to work and light their factories, and, incidentally, to supply any other person or persons who may require a supply. The consent of the local authority could *probably* be gained by lighting the streets (presently lit by the Gas Company) on more favourable terms.

"1. Could you kindly inform me of the proper mode of procedure, and if we must apply for a 'provisional order'?

"2. If the local authority refuses its consent, what difference will that make?"

*** With regard to the first question addressed by "Power Plant," it is necessary to point out that it is competent for any firm, or for any private individual for that matter, to undertake the supply of electricity without being authorised so to do by a provisional order or special Act. The Electric Lighting Acts are enabling only, and do not, save in so far as they render it compulsory for supply companies to comply with the rules of the Board of Trade, place any restriction upon the supply of electricity. Should our correspondent elect to proceed without a provisional order, it will still be expedient, if not necessary, for him to submit to the Board of Trade a plan of the works which he is about to undertake. It is provided by Sec. 4 (1) of the Electric Lighting Act, 1888 (51 and 52 V., c. 12), that where any electric lines or other works may have been laid down in streets, or in such a way as not to be enclosed in a building otherwise than in accordance with, and subject to, the provisions of a licence, order, or special Act, the Board of Trade may cause a notice to be served upon the undertakers requiring them to continue their works, and supply their electricity, only in accordance with the conditions and regulations prescribed by the Board of Trade for the safety of the public and the protection of the property of the Postmaster-General. Seeing that he would render himself liable to the service of a notice of this kind, we are tempted to advise our correspondent, even if he does not apply for a provisional order, to consult the Board of Trade before commencing operations. While, therefore, a provisional order is not essential, it remains to consider whether our correspondent would act prudently in applying for it. The proposed installation will probably involve the uprooting of, or the suspension of cables across, streets and roads, not to mention private property. Is our correspondent in a position to obtain the necessary wayleaves at a reasonable cost? If so, let him proceed without the additional cost of a provisional order. If not, his only method of obtaining compulsory powers is through the medium of a provisional order.

2. With regard to the second question addressed to us, it is clear that the local authority could place serious obstacles in the way of our correspondent's undertaking. For instance, they might withhold their consent to disturbance of the streets if they are the highway authorities, and in that capacity they would be entitled to sue for and recover penalties under the Highway Act, 1835 (5 and 6 Will. 14, c. 50, Sec. 72), Hawkins *v.* Robinson (37 J.P. 662), but of course if the local authority grant their consent, such difficulties would at once disappear.

No. 40.

"Belvedere" writes:—"I shall be pleased if you will be good enough to supply the following information:—

"1. Can a supply company demand payment for services put into houses which are within 60 feet of the supply main? A suburban supply company are sueing in the County Court for 25s. for a service under 20 feet. It is the only instance that has come under my notice. Can custom be pleaded, or can you tell me of any precedent where consumers have not been charged by the same company, but have been put in free?

"2. A company supplies direct current. Are they at liberty to rent current from another company or corporation who generate alternating current? Are they at liberty to supply alternating current to a consumer who has applied for continuous current?"

"The following clause occurs in the company's application form:—

Connection with the Consumer's Premises.—The company will, at its own expense, lay along the public thoroughfare a service line to the boundary wall or fence of the consumer's premises, provided such boundary wall or fence is within 60 feet of the company's distributing mains.

The consumer will pay the cost of:—

1. So much of any service line for the supply of electricity as may be laid upon the property or premises of the consumer; such service line becoming the property of the consumer.
2. Cost of connecting and fixing meter.
3. Cost of laying such length of service line along the public thoroughfare as exceeds the 60 feet mentioned above; this excess length remaining the property of the company."

*** We are not quite clear as to what "Belvedere" means by "services" mentioned in the first question addressed to us. We

presume, however, that he means service lines which are customarily laid between the mains and a consumer's premises. It appears to us that upon the true construction of the clause which our correspondent sets out above, the company exceed their rights in demanding payment for service line laid within 20 feet of a consumer's boundary. By Sec. 27 (1) of the Electric Lighting Clauses Act, 1899, it is provided that the cost of so much of any electric line for the supply of energy to any owner or occupier as may be laid upon the property of that owner, or in the possession of that occupier, and of so much of any such electric lines as it may be necessary to lay for a greater distance than 60 feet from any distributing main of the undertakers, although not on that property, shall, if the undertakers so require, be defrayed by that owner or occupier. In placing the limit of 60 feet, it is clear that the undertakers are acting within their rights.

We have also considered "Belvedere's" second question. Unless there is something in the company's provisional order to prevent their leasing current and supplying the same to their customers, we do not think there is any objection to their doing so. In answer to the second half of the second question addressed to us by "Belvedere," we would refer to a very similar query and answer which was published in the Electrical Review for October 12th, 1900, at page 604. The text of Regulation No. 5 of the Board of Trade Regulations, 1895, which has relation to arrangements for supply to be made to consumers *after* the year 1895, is as follows:—"The standard *pressure* shall be fixed by the undertakers . . . . and shall not be altered except by permission of the local authority, and upon such terms and conditions as the local authority may impose." We are of opinion that the above rule would apply with equal force to a change from continuous to alternating current.

THE ELECTRICAL EQUIPMENT OF THE MANHATTAN ELEVATED RAILWAY.

E. KILBURN SCOTT.

(*Continued from page* 182.)

Sub-Stations.—The sub-stations are seven in number, each 50 feet wide and 100 feet long, with four floors above the basement, the two highest ones containing storage batteries. The lowest floor contains the rotary converters, set on concrete foundations, 12 feet × 15 feet, and 10 feet high. The second floor, which is in the form of a gallery, contains the switchboards and static transformers. Between the galleries a 25-ton crane traverses the space over the converters, while the galleries are served by 5-ton cranes.

The battery rooms are paved with vitrified brick, laid in asphaltum, and all the buildings are provided with electric elevators.

Coal and Ash Conveyer.—The coal will be delivered in barges at the dock, and will be unloaded into the bunkers, situated above the boilers, at the rate of 150 tons per hour. The coal-conveying machinery to do this work consists of a tower equipped with a 1½-ton shovel, also the necessary crusher and weighing hoppers.

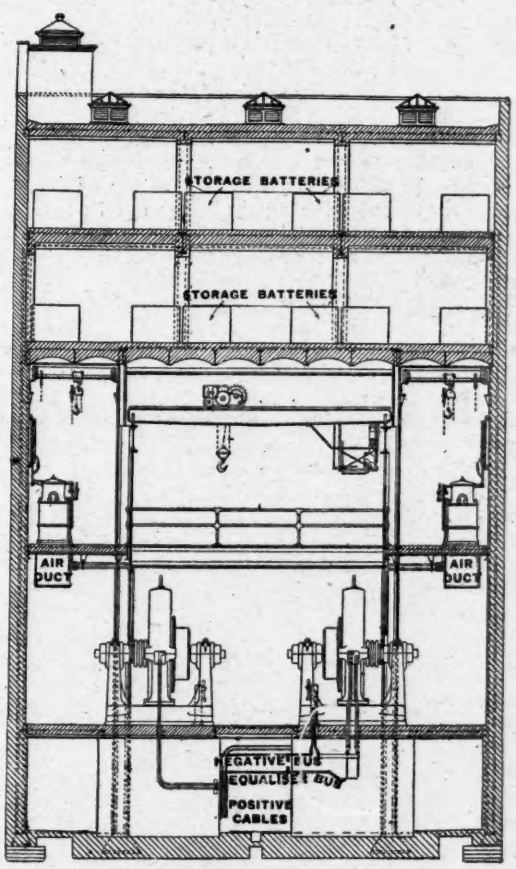
The coal bunkers are capable of holding about 15,000 tons of coal, an amount sufficient to run the entire plant for a period of about 20 days. The coal bunkers are three in number, and are separated from each other by a clear air space 35 feet wide, so that if by any possibility a fire occurs it can be confined to the bunker in which it originates.

After leaving the furnaces, the ashes pass through chutes to the basement, and are conveyed to the ashpit by dump cars, hauled by an electric locomotive. From the ashpit the ashes are carried to storage bins on the river front by a bucket conveyer. One advantage of this arrangement is that the wear and corrosion which always results from the handling of ashes is confined to one short line of buckets, which can be repaired or replaced without interfering with the delivery of the coal.

Boilers.—The boiler equipment consists of 64 Babcock and Wilcox horizontal water-tube boilers, of 500 H.P. each, arranged in batteries of two boilers each. These boilers are fitted with forged steel headers, and are capable of sustaining safely 200 lbs. working steam pressure. The boilers are fitted with Roney mechanical stokers, capable of burning either hard or soft coal. To handle this boiler plant by flat grates and hand firing would require a force of about 270 men instead of the 90 required with mechanical stoking.

Economisers.—One Green's economiser is provided for every two batteries of boilers, thus making 16 economisers in all. The flues are provided with dampers, so arranged that the flue gases may pass directly into the stack or through the economisers. The latter are of the improved high pressure type, and aggregate 8,192 tubes. The use of economisers in this plant is more than usually advantageous from the fact that all the auxiliary machinery is electrically driven; there is therefore no waste steam which could be utilised in auxiliary heaters for raising the temperature of the feed water. The economisers are entirely depended upon to perform this function.

Blowers.—Sixteen Sturtevant blowers furnish forced draught, for although the stacks are designed of sufficient dimensions to furnish the required draught under all ordinary circumstances, yet the plant is subject to such trying conditions, such as sudden increase in load, or unusually low barometer combined with bad coal, while a stoppage even for a few minutes would entail such loss and annoyance, that it was thought advisable to ensure against any possible difficulties due to suddenly reduced steam pressure. Each blower can deliver under the grates of the boilers 57,000 cubic feet of air per minute at a pressure of one ounce per square inch.



Cross-Section of Sub-Station.

Engines.—The engines are by the E. P. Allis Company, of Milwaukee, Wis., and are noticeably different from any hitherto used in railway power plants. A careful consideration of the most suitable size of unit led to the decision that this should be 8,000 H.P., and eight such units are placed in a single row. The engine is of the compound horizontal and vertical cross-compound type, and comprises two compound engines working at either end of the shaft, the high pressure cylinder (44 inches in diameter) being horizontal, and the low pressure cylinder (88 inches in diameter) being vertical. The stroke is 60 inches and the speed 75 revolutions per minute.

The advantages of this type are compactness, a short shaft and only two main bearings, besides which the parts are always

accessible for inspection and repair. Again, the cranks, two in number, are set at 135° apart, and the uniformity of rotation which this engine gives to the shaft, due to the eight impulses of the four cylinders, is essential to the efficient operation of the alternator.

Condensers.—The condensers are under construction by Henry R. Worthington. Owing to the present uncertain state of the art, as regards the extraction of cylinder oil from the water of condensation, and the possibility of radical improvements in this direction, it has been decided that the present installation shall consist of jet condensers, so arranged that each can be changed into a surface condenser, when a satisfactory system has been determined upon for the extraction of the cylinder oil.

All the condenser machinery, both when operating as a jet, and as a surface condenser, will be driven by electric motors, which will run at a constant speed and drive the vertical triplex air pumps at 30 revolutions per minute when operating in connection with the jet condensers; by changing the ratio of gearing they will run the same air pumps at 10 or 15 revolutions per minute when operating in connection with the surface condenser. The circulation of water through the surface condenser will then be performed by means of a centrifugal circulating pump, directly connected to the outer end of the same electric motor.

Water Supply.—Feed water is supplied to the plant by a 12-inch connection to the city water main, 6-inch water meters registering the water as it enters the building. From these meters a pipe line is run along the wall of the building, supplying four large storage tanks of 4,000 gallons capacity each, a float valve being provided to keep the water at a constant level. A branch pipe line supplies the forced injection for the main and exciter engine condensers. The arrangement of meters is such that the water used for other purposes than that of feeding the boilers can be registered independently from the total amount of water entering the building, so that an accurate meter register of the water used for boiler feed purposes can always be obtained.

A centrifugal motor-driven pump can supply river water (salt) to the boilers in case the city water is shut off for any cause.

Feed Piping.—From the boiler feed pumps water is delivered to a ring main below the first boiler floor. On the delivery pipe of each pump an automatic relief valve is placed to protect against excessive pressure. The ring main encircles the boiler room, the pumps feeding into it first on one side and then on the other.

Steam.—The steam piping consists of eight sections, each section connecting four batteries of boilers to one engine. Eight boilers are arranged in a group opposite an engine, and there is thus secured the shortest distance for the steam to travel, with little lateral flow and minimum loss from condensation. A steam reservoir, 36 inches in diameter and 24 feet long, is installed at each engine. From this reservoir a steam pipe runs to each of the two high pressure cylinders of the engine.

Flanges for wrought-iron pipes up to 5 inches are of screwed cast-iron; above 5 inches the flanges are of steel, welded on.

Both high and low pressure valves are all of the adjustable disc pattern and are by the Best Manufacturing Company, of Pittsburg.

Exhaust.—A 42-inch exhaust pipe is placed in the basement on the south side of the engine room; in the centre of the building a branch runs below the engine-room floor, and is connected to a riser ending in an exhaust head above the roof. The expansion joints in this exhaust pipe are the only ones used in the piping system.

Exciters.—The engines driving the four exciters are of the direct-connected tandem compound piston valve type, and known as the Harrisburg standard side crank self-oiling engine. They are each 15 inches and 25 inches by 18 inches stroke, and the normal rating, when running at 150 lbs. steam pressure condensing, and at 200 revolutions per minute, is 300 H.P. They are direct connected to 250-KW. 250-volt multipolar generators of the Westinghouse make. Each exciter is capable of exciting four alternators.

The Third Rail Construction.—The third rail is standard Vignoles section weighing 100 lbs. per yard, and is rolled in 60 feet lengths. To obtain a rail having the greatest conductivity, an investigation was made of the effect of various compositions on the resistance of steel, and the conclusion was reached that a reduction in the percentage of carbon and manganese tended to increase the conductivity. The composition adopted, therefore, was as follows:—carbon, ·073 per cent.; manganese, ·341 per cent.; sulphur, ·073 per cent.; phosphorus, ·069 per cent.

The use of the above composition results in a rail too soft for ordinary railway service, but tests show that the value of the rail as a conductor has been increased, the resistance measuring only about eight times that of copper of equivalent section.

(*To be continued.*)

ELECTRIC TRANSMISSION IN FACTORIES AND MILLS.

A PAPER under the above heading has recently been read before the American Society of Mechanical Engineers by Mr. William G. Aldrich, and contains some points of interest to works managers in this country who are adopting electrical power in their shops. Below we have extracted and commented on some of the more interesting points.

The writer commences by pointing out that electrical power, on entering this new field, has had to contest every inch of its progress in competition with long-established usage in order to displace the unwieldy and unsightly power transmissions by shafting, belting, and rope drives. He also states that there are many factories and mills into which the introduction of electricity for power transmission will not pay under existing conditions, whilst there are other establishments in which it will pay, and in which an investment in electric transmission would prove to be a dividend-paying investment. Each case must be carefully examined, and a most thorough preliminary survey made of all the conditions and requirements.

Everyone conversant with power distribution in factories will approve of the above remarks, as cases are frequently met with where the substitution of motors for the existing methods of driving would not ensure economies to justify the capital outlay, and where an attempt at this substitution would be likely to damage the reputation of electrical power for effecting economies.

It is very rightly pointed out that each year more and more machinery is thrown on to the scrap heap to make room for new and improved types, whilst antiquated and costly methods of transmitting power are left in service. Modern methods of workshop production, in which machine tools are worked up to the power limit, are seen to be sought after side by side with belted transmission of power, which makes it quite impossible to realise fully the value of the new method, by not giving the operator the utmost freedom of speed control of machine and tool.

Electric motor drives provide suitable and quickly adjusted speed ranges under all the ordinary starting loads of workshop appliances. It is contended that this has increased the output from 10 to 80 per cent. compared with the old and fixed speed conditions with belts and gears.

It is further shown that electrical measuring instruments have shown the electrical transmission method to result in savings of from 20 to 30 per cent. of the power required by the old method.

Electric, Steam, Compressed Air, and Hydraulic Transmission.—Some practical remarks are made under this heading. It is pointed out that electric transmission for a manufacturing establishment is the only one which admits of economically centralising the so-called mechanical plant, supplying light, heat, and power. The advantages of concentrating the generating plant are well known to those who have had to design and scheme the general arrangements of a works.

The sub-division of the generating plant into duplicate interchangeable units, which the electrical system makes

easy, is an important point upon which sufficient stress is often not laid. Further, the generating plant may be operated at all times in such a manner that each engine is loaded to its normal capacity.

Night shifts can be supplied with power in units to suit their work, instead of requiring the usual single large engine to be operated as in the ordinary day shift. Further, nearly uniform loads may be maintained on the engines, both day and night, the electric light load at night off-setting the additional electric motor service during the day time.

These points will be appreciated by those that have had charge of a plant laid out on old lines, and who will grasp the difficulty, in most cases impossibility, of effecting economies on the lines enumerated above, without substituting electrical transmission.

Compressed air and hydraulic pressure perform certain operations in manufacturing work more efficiently and cheaply than electricity, and into these special fields electricity does not seriously enter.

The paper points out that for all manufacturing operations, except the very highest, requiring rotary motion, continuous or intermittent, uniform or variable, and reversible or otherwise, electric motors provide the readiest facilities.

On the other hand, for certain very definite reciprocating movements, with fixed time or distance limits, hydraulic mechanisms are best suited, though electric motor-driven hydraulic mechanisms with hydraulic control have proved admirably adapted to this class of work. For reciprocating movements, however, requiring a cushioning effect, compressed air is best adapted.

It is stated, further, that for efficient service compressed air requires to be reheated and used expansively in a cylinder, with all parts and mechanisms practically the same as in a steam engine.

For general power transmission over short distances, such as are met with in factories and mills, compressed air and hydraulic pressure do not seriously compete with electricity.

Efficiency of Transmission at Variable Loads.—It is pointed out that the mechanical friction, such as is found in steam engines, shafting, &c., remains practically constant within all ordinary ranges of loads and at uniform speeds, and, consequently, the efficiency of any mechanical system, as an engine driving shafting, rapidly falls off below full load.

This fact will be gathered from the following figures, which represent the combined efficiency of an engine driving heavy machinery, the indicated horse-power of the engine being about 275 :—

While at full load (or 100 per cent. load) there is 45 per cent. available for useful work at the tools, at three-quarter (75 per cent.) load there is only 28 per cent. available for work, and at a load of 55 per cent. of the full load, there is nothing left for work, all power being consumed in overcoming the combined friction of the engine and the transmission machinery.

In the electric transmission of power for manufacturing purposes, the distances are so short that there is no necessity for considering any of the so-called line losses which figure so prominently in long-distance electric transmission, the only losses which have to be taken into account being the inherent losses which accompany the transformations of energy from steam power into electric, and finally to motive power. Electric motors have the characteristic feature of high maintained efficiency at part load.

The figures given below will show the corresponding efficiency for the electrical transmission system, which are comparable with the figures given above for the mechanical system.

Taking a case where 20 10-H.P. motors are used, which corresponds in size to the one given above, and for which the mechanical efficiencies are given, it is shown that at full (100 per cent.) load, 63 per cent. of the power applied at the engine is available for useful work; at three-quarter (75 per cent.) load, 62 per cent. of the power is available; at half (50 per cent.) load, 51 per cent. of the power is available; while at something less than one-quarter load, all of the power applied is required to supply the losses in the engine, dynamo and motors. It is not so much a question what the friction horse-power (or its per cent. of the total) may be at any load, such as the normal, as it is a question how the total or combined efficiency of the system is going to vary with the load.

The best performance of the mechanical system of transmission by shafting and belts is at full load. The best performance of the electric system may be maintained from 75 to 125 per cent. of the full load. These differences are important, when it is borne in mind that very few factories and mills are operated at full load all day.

For machine shop practice, for instance, an average of about half time for the actual work would be rather liberal. The losses at these light loads are exceedingly expensive on the mechanical system of transmission, but scarcely require consideration in the electric system.

In fact, by proper selection of dynamo and motor a combined efficiency at half load may be obtained equal to that at full load. The all-day efficiency of the electric system may thus be made very high.

Systems of Electric Distribution for Factories.—It is pointed out that for manufacturing work it is not necessarily best to have the single system that will the most readily lend itself to all of the work to be performed for light, heat and power service. The lighting service, for instance, need not be more expensive, and will often be more satisfactory, if supplied independently of the power service. Although this is undoubtedly true in some cases, yet it is very desirable to have a plant for lighting which can be thrown into parallel with the power plant if required.

Direct and alternating currents are stated to be equally adapted for factory transmission, whilst the use of storage batteries, rotary converters and transformers is not advocated, a direct distribution being preferable.

In the matter of voltages it is pointed out that anything between 110 and 550 volts is practicable, though the latter figure is given as the maximum desirable. Experience in this country has led one to believe that a pressure of 220 volts is quite high enough to have in the shops, as small motors are not quite as satisfactory when working at a high pressure. Any increase in the pressure above this also causes some difficulty with the lighting, due to the large number of lamps required in series.

Electrical Transmission by Direct Currents.—For the peculiar and exacting service required in driving all kinds of machine tools and various workshop appliances, it was necessary to secure satisfactory methods of producing a large starting turning moment, or torque, and of varying the speeds as might be required under uniform or variable loads. With direct current motors this was a simple matter, as a resistance in the armature circuit would control the torque to a nicety, whilst a rheostat in the field circuit would give the necessary speed control.

These means of regulating the speed and torque are, however, condemned in favour of the more complicated systems introduced by Ward Leonard. In this country, however, the less complicated system is preferred, even at the slight expense of energy which is necessarily wasted in the resistances in obtaining the required results.

The paper points out that the difficulties with commutators have been almost entirely overcome, and many refinements in design effected, so that the direct current motor of to-day leaves little to be desired.

On the whole, we should gather from the remarks made that the writer of the paper prefers alternating motors for power work, though his arguments in their favour are not very convincing.

The remarks under the above heading conclude by saying that if a motor had been sure of the daily care and inspection formerly bestowed on shafting and belting, it would have made a much better record earlier in its history. Undoubtedly there is much truth in this statement, yet a good continuous current motor must be capable of running for several days without cleaning or attention if it is going to effect the full economies often put forward.

Electric Transmission by Alternating Currents.—Induction Motors.—The paper urges that the induction motor, as it stands to-day, is possibly the most perfect motor yet developed from the standpoint of electric transmission in factories and mills, and has offered practically the only alternative to those engineers and manufacturers who did not care to be troubled with the petty annoyances and

delays likely to occur at any time with the direct current motor.

Offsetting the advantages of induction motors, certain restrictions are mentioned, such as the falling off in speed as the load is increased, and the sacrifice of efficiency to enable an induction motor to start from rest under a heavy load, as well as to make possible speed changes during its operation.

In our opinion, however, these objections are not the only ones. That induction motors possess certain advantages over continuous current motors is not to be disputed, and that they are eminently suited for certain classes of work is also true, yet they are accompanied by certain disadvantages which limit their use in factories and mills.

The paper says that, as a rule, machine tools and almost all classes of shop machinery are started at quite light loads, and the full load is thrown on when the work or the tool is up to the speed desired. For this class of work, it adds, the induction motor seems specially fitted.

Undoubtedly this is the case, but the difficulty is that in almost every shop a few tools have to be driven which require a very heavy torque at starting, often three or four times the normal torque of the motor, and when these cases are met with, the multiphase induction motor is a good deal more difficult and expensive to adapt than the continuous current motor.

Further, for individual tool driving, heavy torques are continually being thrown on to the motor, and unless this has been specially arranged for—at the expense of efficiency at ordinary loads—the induction motor is likely to pull up.

It is pointed out that a larger generating plant is required for an installation of induction motors than would be the case if direct current motors were used. This is on account of the low power factor of all classes of alternating current circuits in which there is considerable self-induction, whether in the transmission wires or in the appliances used.

In the case of induction motors this effect is very appreciable at light loads, becoming much reduced at average and heavy loads, at which it is almost uniform.

Another point, in our opinion, often overlooked when installing multiphase motors, is the question of arc lighting.

Continuous current lamps are eminently suitable for factory lighting, whilst alternating lamps are not so satisfactory or suitable.

Synchronous Motors. — The author contends that synchronous motors are admirably adapted to factory service, where absolute uniformity of speed is required, and where the extra installation of a direct current supply for their field excitation is not deemed objectionable.

In our opinion, however, the necessity of a mixed plant for performing what continuous current will do alone, is not likely to commend itself to works managers in this country for ordinary power work.

Synchronous motors of the revolving field type are self-starting from rest at light loads, and can be overloaded at least three times their normal load without dropping out of step. As pointed out, however, elsewhere, this is not sufficient for some power work, and almost every shop fitted up for motor driving will have some tools which will entail a more severe strain on the motor than the synchronous motor will stand, unless installed of an abnormally large size.

Combined Induction and Synchronous Motor Working.—It is urged that the ideal condition in a factory installation would be secured where both induction and synchronous motors were used, the former for small machines and direct driving, the latter for operating a set or group of machines.

The synchronous motors would be started up just before beginning the work of the day, but at all times a light constant load, and might easily be so regulated as to produce an almost balanced system in combination with the induction motors.

It is doubtful, however, in our opinion whether a system necessitating different types of motors in a single factory would be likely to commend itself in preference to more simple systems.

Economies Effected by Electric Transmission.—It is shown that whilst one would naturally expect that the greatest savings would be noticed in those factories designated in the earlier part of the paper, as engaged in heavy machine work, where the loss in shafting and belting amounts to over 50 per cent. of the total power developed at the engine, yet many small industries have introduced electric driving to marked advantage.

The following four cases are cited :—

1. Electric driving reduced the cost one-half over the former method for attendant, coal and water.

2. Fuel account by electric driving was reduced to one-fifth of what it formerly was with shafting and belting.

3. Cost of power was made 44 per cent. lower than what it was with shafts and belts.

4. Gross saving about 30 per cent. with direct-coupled motors, and 22 per cent. with geared or belted motors.

In conclusion, the paper, on the whole, contains much interesting information, though the writer has undoubtedly rather inclined towards alternating working, and to some extent ignored the simplicity and extreme flexibility of the direct-current system, when applied to the problems met with daily in applying motors for power work.

If an alternating system is laid down in a factory for power purposes, additional continuous current plant must be installed, to supply the cranes and those tools and machines requiring heavy starting torques, and further for supplying the power for the lighting.

If, however, only one system is to be installed, the continuous current system possesses undoubtedly the most advantages, and is best adapted for general power work in factories and mills.

CURRENT SPECIFICATIONS.

XLVIII.—STIRLING EXTENSION PLANT.

SUMMARY.

Extent of Contract.—Supply and erection upon prepared foundations of two 220-KW. steam dynamos.

Type of Engines.—To be vertical, inverted, compound type, three-crank, and preferably of enclosed type.

Specified Speed.—Not to exceed 380 revolutions per minute.

Stipulated Overload.—To be able to indicate 25 per cent. additional output for short periods.

Conditions of Working.—The full output to be obtained when the engines are supplied with steam at 150 lbs. per square inch pressure, and exhausting to atmosphere.

Permissible Variations of Speed.—When the whole load is suddenly thrown off, the variation of steady speed is not to exceed 3 per cent., and of momentary speed 10 per cent.

Specified Steam Consumption.—Not to exceed at most economical load 21 lbs. per *electrical horse-power-hour*, working non-condensing, with 150 lbs. per square inch steam pressure. This is equivalent to 28 *lbs. per kilowatt-hour.*

Output of Steam Dynamos.—Normal output = 220 KW.

Size of Dynamos.—Machines to be suitable for either lighting or traction. When used for lighting as shunt machines, to develop up to 440 amperes at 500 volts. When used for traction to develop as compound-wound machines 400 amperes at 550 volts. Maximum current × by maximum volts=440 amperes × 550 volts=242 KW. Dynamos to be able to give for short periods 25 per cent. overload.

Spare Armature.—One to be supplied, interchangeable with either machine.

Stipulated Combined Efficiency.—Not to be less than 84 per cent. at full load.

Permissible Temperature Rise.—After six hours' run with 440 amperes, not to exceed 70° F. above surrounding atmosphere.

Date of Completion.—To be specified by tenderer.

Penalty for Late Completion.—£20 per week.

Specified Period of Maintenance.—Twelve months from completion of work.

Specified Terms of Payment.—Payments up to 75 per cent. of work done during progress on engineers' certificates, on delivery on site further instalments to be paid up to 85 per cent. of contract sum, a further 10 per cent. to be paid on taking over, and 5 per cent. at end of period of maintenance.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages paid to Workmen.—None.

Arrangements as to Sureties.—Names of two sureties to be given by tenderers, or, as an alternative, the retention money may be increased from 5 to 10 per cent.

Arbitration.—Provisions satisfactory.

Date for Receipt of Tenders.—February 15th, 1901.

This specification for extension plant for the Stirling electric lighting undertaking has been prepared by the Council's consulting electrical engineers, Messrs. Kennedy and Jenkin, of Westminster, S.W.

It will be noticed that in accordance with modern custom the dynamo is to be suitable for use for both lighting and traction purposes. In this case it affects to an appreciable extent the size of the machine, and tenderers will do well to make ample provision for the specified overload of 25 per cent. for short periods.

The date of completion, which tenderers can accept under a penalty of *£20* per week, is to be stated in the offer.

The general conditions are exceedingly fair, the penalty clause being binding, "except in so far as such delay (*i.e.*, beyond the promised date) may be caused by fire or strikes of workmen," and an arbitration clause in the following terms being included:—

Should any dispute arise as to the true intent and meaning of these general conditions and regulations, and the formal contract to follow hereon, or of the specifications, drawings, schedules, the fulfilment thereof, or the settlement of accounts, or as to the value of any additional work to which the schedule rates cannot be applied, the same shall be referred to the President of the Institution of Civil Engineers for the time being, or some member of the Institution nominated by him. Any decision, interim or final, of the arbitrator so appointed shall be finally binding and conclusive upon all parties.

XLIX.—SOUTHAMPTON ELECTRIC TRAMCARS.

Summary.

Extent of Contract.—Supply of eight electrically equipped tramcars, the option being reserved to the Corporation to order up to four more at same price at any time up to six months from date of tender.

Type of Car.—To be double-deck type, each capable of seating 55 passengers—22 inside and 33 outside.

Gauge of Line.—4 feet 8½ inches.

Design of Car Body.—To be in accordance with drawing accompanying specification.

Type of Truck.—"Brill" or "Peckham" standard trucks to be included in tender, but alternative offers may be made for other types.

Type of Wheels.—To be obtained from Messrs. Miller & Co., of Edinburgh, New York Car Wheel Works, or other approved maker.

Type of Motor.—Specified to be of Thomson-Houston, Westinghouse, or Walker Co.'s make.

Capacity of Motors.—The two motors to be capable of propelling a fully loaded car up a gradient of 1 in 15 at a speed not less than five miles per hour.

Maximum Speed.—To be 10 miles per hour up a gradient of 1 in 50.

Armature Flashing Test.—2,500 volts applied between armature windings and core.

Commutator Flashing Test.—5,000 volts alternating between segments and shaft, and 500 volts alternating between adjacent segments.

Magnet Coil Flashing Test.—5,000 volts alternating between windings and magnet frame.

Type of Controller.—To be of series parallel type, embodying magnetic blow-out principle with reversing and emergency stop connections.

Type of Trolley.—To be of swivelling pattern, with standards having enclosed springs of similar type to those at present in use.

Type of Lightning Arrester.—Wurts or magnetic blow-out type.

Specified Date of Delivery.—Eight complete cars in three months from date of order.

Penalty for Late Completion.—One half per cent. of value of contract per week, the total sum being divided into Section A for car bodies and trucks, and Section B for motors and electrical equipments.

Specified Period of Maintenance.—Six months from date of completion.

Specified Terms of Payment.—Up to 80 per cent. on delivery on site, 10 per cent. on satisfactory completion, 10 per cent. six months later.

Stipulations as to Removal of Foreman or Workmen.—Acceptable.

Stipulations as to Wages paid to Workmen.—See notes below.

Arbitration.—No arbitration provided for in general conditions, see notes below.

Sureties.—Two to be provided, to be bound jointly and severally in sum equal to 15 per cent of contract.

Date for Receipt of Tenders.—February 11th, 1901.

Messrs. Kincaid, Waller & Manville are responsible for the drafting of this specification. We consider that the stipulation that the motors shall be one of three makes, especially when one of the firms thus favoured has been merged into one of the other two, unduly limits competition. If insisted upon in its present form it means that the order will be awarded to one of two firms who manufacture their goods in the United States. This means that they cannot be held liable under the following clause, which obviously is only applicable to this country:—

The contractor shall pay the men employed by him not less than the minimum local standard rate of wages, as settled from time to time by the Masters' Association and the trades unions respectively in each branch of the trade at the date of this contract.

The same course of action is pursued with regard to the trucks when tenders must be given for one or two American trucks, though here alternative offers may be made for other types, which, of course, permits of the competition of the British made article.

We hold that to insist upon the payment of special rates of wages for work done in this country, and at the same time to express a preference for foreign goods made in countries where these special conditions are not applicable is not fair. It places the British manufacturer at a great disadvantage, and we consider that, especially in cases where the expenditure of public money is involved, every care should be taken that no unfair advantage is given to foreign trade competitors.

No provision is made in the general conditions for the submission of any disputes to the decision of an independent arbitrator, and we strongly urge all tenderers to stipulate that such an arbitration clause as that agreed upon between the members of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association be inserted in the final contract.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

1,309. "Improvements in breaks to be used in connection with railway cars and wagons, tramcars, electric cars, or other vehicles running on rails." W. Smithson. Dated January 21st.

1,330. "Improvements in electric trolleys." C. A. Allison. (The Penberthy Injector Company, United States.) Dated January 21st. (Complete.)

1,340. "Improved apparatus for registering maximum electric currents." A. W. Brown. Dated January 21st.

1,347. "Improvement in telephone exchange systems." J. E. Kingsbury. (The Western Electric Company, United States.) Dated January 21st.

1,372. "Improvements in or connected with gas, electric, or other meters." J. W. Wedderburn. Dated January 21st.

1,396. "Improvements in or relating to wireless telegraphy." A. J. Boult. (M. R. Garcia, France.) Dated January 21st.

1,400. "Improvements in electrical switches." H. Nunns. Dated January 22nd.

1,401. "Improvements in controlling arrangements for electric lifts." J. S. Stevens, C. G. Major, E. C. Stevens, and P. H. Stevens. Dated January 22nd.

1,403. "An improved apparatus for the electrolytic production of copper tubes and sheets." S. Cowper-Coles. Dated January 22nd.

1,461. "Improvements in telegraphic relays." E. Ducretet. Dated January 22nd. (Complete.)

1,468. "Improvements in electro-motors." W. B. Hodgetts. Dated January 22nd.

1,471. "Improvements in electric arc lamps." L. F. Bogia. Dated January 22nd. (Complete.)

1,474. "Improved electric lamp for photographic purposes." A. L. Adams. Dated January 22nd.

1,484. "Improvements in means to be employed in the electro-deposition of metals." S. O. Cowper-Coles. Dated January 22nd.

1,485. "Improvements in electrical measuring instruments." H. P. Ball. Dated January 22nd. (Complete.)

1,488. "Improvements in electric measuring instruments." H. Brooker and W. J. Russell. Dated January 22nd.

1,504. "Improvements in apparatus for governing electric currents." A. W. Gattie. Dated January 23rd.

1,505. "An improved electrical fire alarm." E. Barnard and H. Stedman. Dated January 23rd.

1,506. "Improvements in or relating to arc lamps." W. Routledge. Dated January 23rd.

1,527. "Improved automatic electrical attachment for clocks for ringing bells and other purposes." W. Clapham, A. Clapham, and A. Clapham. Dated January 23rd.

1,553. "Improvements in poles for supporting electric trolley wires upon electric tramways." J. Slack. Dated January 23rd.

1,564. "Improvements in or connected with electrical switches having intermittent or step-by-step motions." W. Kingsland. Dated January 23rd.

1,568. "Improvements in electric cables." M. J. P. O'Gorman. Dated January 23rd.

1,578. "Improvements in or in connection with electric lighting devices for tramcars." F. T. Stewart. Dated January 23rd.

1,600. "A system of electric circuits with sectional conductors for tramways and the like." K. Hora, J. Rydl, and F. Vsetecka. Dated January 23rd. (Complete.)

1,624. "An improved winding machine and reel for hose ropes, electri cables, telegraph wires, and the like." F. Lever. Dated January 24th.

1,662. "Improvements in or relating to trolleys and like current collectors for electric railways and tramways." R. R. Gibbs. Dated January 24th.

1,663. "Improvements in or relating to trolleys and like current collectors for electric railways and tramways." J. Higgett. Dated January 24th.

1,670. "Improvements in electrical eye-glasses or spectacles." T. Berndt. Dated January 24th. (Complete.)

1,705. "Improvements in the electrolytic manufacture of metal wire rod and strip." S. Cowper-Coles. Dated January 25th.

1,721. "Electric balance for indicating or signalling maximum or minimum electric pressure or current." B. Brander. Dated January 25th.

1,742. "Improvements in dynamo-electric generators." B. G. Lamme. (Date applied for under Patents, &c., Act, 1883, Sec. 103, June 28th, 1900, being date of application in United States.) Dated January 25th.

1,743. "The electric radiant heat and light cabinet for medical or curative purposes." S. W. Anstee. Dated January 25th.

1,769. "Improvements in electric tramways or railways." E. Dussek. Dated January 25th.

1,788. "Improvements in or connected with alternate current motors." R. D. de Lignieres. Dated January 25th.

1,809. "Improvements in electric railways." J. M. Taylor. Dated January 26th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

5,104. "Reinforcement of electrical waves and avoidance of loss by straying reflection and the like by means of a condenser." F. Braun. Dated March 8th, 1899. In order to avoid loss of energy in wireless telegraphy, a number of condensers are employed, each having a separate air-gap. The condensers are charged by an induction coil or other means and connected to the usual vertical wire. The condensers are as nearly spherical as possible, and may be formed by embedding the inner plate in the earth, being the spark-gap. In the modified arrangement induction coils are arranged between each condenser. 4 claims.

5,199. "Improvements in electrolytic decomposing apparatus." T. J. Holland and A. P. Lawrie. Dated March 9th, 1899. An electrolyte apparatus, suitable for decomposing brine, consists of an outer tank provided with metal cross-partitions reaching from its upper edge nearly to the bottom of the tank. These partitions, and the tank also if the latter is formed of metal, constitute the cathodes, and are connected to the terminal. Within each compartment thus formed is placed a closed porous cell having arranged around its walls on the inner side a number of carbon rods or plates, forming anodes, which project above the cell to a conductor connected to the main positive conductor. Passing through the cover is a perforated tube, which is filled with salt. The cells and outer tank are charged with brine. In use, chlorine is led away by the tubes leading to a main gas tube while caustic soda is withdrawn, when the strength is sufficient, through a draw-off tap. The salt in the tubes is gradually dissolved, thereby keeping up the strength of the liquid within the cells. In a modification, the brine is continuously charged into the outer tank at one end and withdrawn from the other, the plates being arranged so as to alternately leave a space at the top and at the bottom of the tank, thus ensuring a circuitous course to the electrolyte. 1 claim.

5,211. "Improvements in electric incandescent lamps." A. H. Miller. Dated March 9th, 1899. Two filaments with a common middle connection, or the two halved of a looped filament with a middle connection, are supplied with current either in parallel or in series or singly by a ring of insulating material rotatable between two shoulders on the cap of the lamp, and carrying two metal contacts to connect four fixed spring fingers in pairs. A finger is connected permanently to the middle connection, another finger to one terminal, another to the outer end of one filament, and the fourth finger to the outer end of the other filament and the other terminal, which is the cap 12 per cent. 2 claims.

5,228. "Improved method of and apparatus for making and breaking or varying high potential electric currents." The British Thomson-Houston Co., Ltd. (E. M. Hewlett.) Dated March 9th, 1899. Relates to means for making and breaking high potential circuits. In breaking a circuit a coil having impedance is first introduced into the circuit, the impedance is then increased, and finally the circuit is broken. The main circuit is fitted with switches, and a transformer is arranged in shunt with the switch. The secondary of the transformer is closed by a bridging piece and also by a conductor joining the sliding carbon blocks. To break the circuit the switch is first opened and the main current sent through the primary of the transformer. The resistance of the secondary and the reactance of the primary is then increased by moving down the bridge and the carbons. The switch is then opened. The coil operates a circuit breaker throwing in the transformers. In the circuit of the latter is a coil controlling the catch of a weighted arm, which controls a resistance device for increasing the resistance in the secondary of the transformer. The arm also carries a contact which closes a battery circuit, and the circuit is finally opened by the switch. The variable resistance comprises a metallic vessel containing acidulated water and a contact plate suspended from a pivoted arm. Contacts adapted to engage the contact are fitted on the bottom of the vessel. 19 claims.

5,250. "Improved electric brake." C. W. Hill. Dated March 10th, 1899. Relates to a brake applied by a spring or weight and released by an electro-magnet. The disc is mounted on a feather on the shaft between two leather-faced discs, the one fixed to the framework, and the other free to move axially but locked as regards rotary motion. The disc is held up by a spring with a pressure sufficient to hold the disc stationary; it is drawn back, when required, by the action of an electro-magnet. By using a series of discs the power of the brake may be increased. 2 claims.

5,310. "Improvements in microphones." P. Germain. Dated March 10th, 1899. Microphones are formed with the granulated material, rods, lozenges, &c., consisting of an intimate mixture of baked carbon and a metal such as silver or copper. The mixture may be formed by carbon and the sub-divided metal, or by carbon and the metal reduced from an oxide or salt. 3 claims.

5,356. "Improvements appertaining to electric arc lamps." H. Bennett. Dated March 11th, 1899. Arc lamps. A carbon holder slides on guides, and is connected by a cord, a chain, or a rack with a pulley or a pinion on a cylindrical barrel, which is rotatable in bearings in the frame of the lamp. The barrel supports a loose bearing for a cam lever which is linked to the movable core of a series solenoid, and the bearing is acted on by a spring, so that movement of the core into the solenoid causes the cam to grip and turn the barrel, with the loose bearing, in opposition to the spring and to separate the carbons. The cam lever may be linked to the piston of a dashpot. The lamp may be arranged with the carbons below the regulating mechanism, either or both carbon holders being movable, and a weight being used to raise the lower holder in one form. 1 claim.

5,374. "Improvements in and relating to electro-therapeutic baths and the like." J. J. Stanger. Dated March 11th, 1899. Relates to apparatus for the medical treatment of the human body, by means of which the whole body, or a limb thereof, may be brought into contact with an electrically-charged fluid, which may be either a liquid or a vapour. A rectangular bath is constructed of wood or other non-conductor of electricity. Along the two sides or ends are arranged carbon electrodes, supported in wooden frames and supplied with current through metal connecting pieces. An electric meter, resistances, and a switch are provided for regulating the current. For treating only a portion of the body, the fluid may be directed through a nozzle forming one of the electrodes, the other electrode consisting of a wire-gauze breast plate attached to the body by bands or straps. Alternatively the patient may recline upon a conducting-plate arranged on the floor of the bath and forming one of the electrodes, while the fluid is directed on to the affected part by means of a nozzle. In the arrangement for using a vapour, such as steam, the vapour is generated in a vessel heated by a fuel box and having an outlet cock to which is connected a nozzle forming one of the electrodes, the other electrode being secured to the body. A pair of vapourisers or a single vapouriser with two discharge nozzles may be used for directing two currents of vapour on to a limb. In another arrangement, the outlet tube of the vapouriser forms one electrode, which is gripped by the patient, while a metal rod within it forms the other. An arm bath provided with a metal electrode at one end, and a foot bath made of conducting material, forming one of the electrodes, are also described. 7 claims.

5,392. "Improvements in controlling switches for electric motors." H. A. Earle. Dated March 11th, 1899. Switches for motors. A single handle and set of contacts and resistances are employed for starting, reversing, &c., motors. Two switch arms are separately pivoted, and either may be manipulated by the handle, which is fitted with a catch adapted to engage with a pin. Both arms are weighted so that they return to the "off" position when the catch is released. The arms are fitted with contacts rubbing over the resistances, and also with insulated contacts adapted to connect the contacts. 1 claim.

5,398. "Improvements connected with electric traction on the conduit system." E. Bede. Dated March 11th, 1899. Electric railways and tramways with mechanically-operated contacts in a conduit. Connection is made between a bare or insulated cable by push-pieces pressed into contact therewith by the collector, the push-pieces being carried by india-rubber or other elastic sleeves and necks. Similar arrangements may also be used for the return, or the conduit itself may be used as the return with the view of minimising induction and external leakage. The conductor may be laid in a conduit formed of two angle bars laid near the rail, or it may be otherwise supported adjacent to the rail which forms one side of the slot, and protected by a plate. The conductor may be in lengths like the rails, and coupled by sleeve with tightening-collars surrounded by insulating material, and rendered accessible by a short removable length of one of the slides of the conduit. The collector consists of a board with a conducting strip to bear on the push pieces, and arranged to hold them closed until the circuit is broken to avoid sparking inside the switch. Springs and wheels may be used to keep it in position, and suitable levers used for lifting it. At the points an additional push-piece is mounted in a tongue of the rail to bear on the main push contact. For cleaning the conduit, a rotary brush partly held by a brake is used. 7 claims.

5,416. "Improvements in swing break switches for electric currents." J. J. Walklate. Dated March 13th, 1899. A U-shaped blade or brush pivoted is formed with extensions connected by a bar or pin. A spring fixed at one end, and with the other end secured to the pin, gives a quick make or break when the loose handle is operated. 1 claim.

5,460. "Improvements in and relating to incandescent bodies for electric incandescent lamps." W. L. Wise. (O. M. Thowles.) Dated March 13th, 1899. Incandescent lamps. A filament of U-shaped, or a button, mantle, or other incandescing body, consists of a layer of conducting material on a non-conducting support, and is mounted in an exhausted bulb. The support may be hollow and contain a conducting core, consisting of an ordinary filament, a metal wire or a fibrous thread soaked in a metallic salt, dried and carbonised to convert it into a compound of carbon with iron, manganese, tungsten, or a metallic oxide. Or the core may be made by forcing a mixture of such materials through a die and carbonising. The non-conducting support may be made by soaking cotton braid in nitrate, silicate, or other salt of alumina or magnesia or the like substances, applying it to the core, and heating to a high temperature, electrically or otherwise. Or a paste containing the non-conducting material may be applied to the core by a brush; or the non-conducting material may be fused on, or applied chemically. When no conducting core is used, the non-conducting support is coated with a conductive layer of platinum, by applying a mixture of dry chloride of platinum with oils of rosemary and lavender, and heating in a muffle or Bunsen flame. The conducting layer may be formed by flashing the support in a gaseous or liquid hydrocarbon or in a mixture of a hydrocarbon or hydrogen with silicon chloride or other haloid salt vaporised by heat, to deposit silicon, zirconium, niobium, molybdenum, or a carbide; metallic oxides, or mixtures of carbon with magnesia or other substances, may be used as conductive layers. The core may be left in the filament, or may be removed mechanically, chemically, or by electrically burning it out. The conductor may otherwise be a separate tube, fitting loosely on the support. 12 claims.

5,468. "Improvements in the electro-deposition of metals." A. Zimmermann. (Dr. Courant.) Dated March 13th, 1899. Electrolytes for potassium cyanide depositing baths are obtained by dissolving in cold water the triple salts prepared by treating the potassium cyanide double salt with sulphurous acid. The salts, which may thus be prepared, are the copper triple salt Cu_2Cy_2 $4KCyK_2SO_3$, the zinc triple salt $ZnCy_2 2KCyK_2SO_3$, the silver triple salt $Ag_2Cy_2 2KCyK_2SO_3$, the gold triple salt $Au_2Cy_2 2KCyK_2SO_3$, and the nickel triple salt $NiCy_2 2KCyK_2SO_3$. By varying the mixtures of the copper and zinc triple salts, bronze and brass baths may be obtained. 2 claims.

5,486. "Improvements in electric incandescence lamps." G. C. Allingham and W. Fennell. Dated March 14th, 1899. Incandescent arc lamps. An incandescing rod, of material which conducts only after preliminary heating, is heated by an arc moved automatically along it and then extinguished, when current is supplied to the lamp. The arc may be carried by a movable electrode, which is preferably of iron or other suitable material to produce an arc of low temperature. 7 claims.

5,514. "Improved electric light apparatus for taking photographic portraits." G. W. Morgan. Dated March 14th, 1899. Lighting arrangements. Relates to an arrangement of electric arc lamps, reflectors and diffusers for lighting studios. The arc lamps are suspended from rods at different heights. Behind each arc is a reflector, and in front and beneath it a diffuser which can be lowered out of action by cord. A sloping screen of semi-transparent glass is placed between the lighting arrangement and the studio, removable panes being used to give access to the lamps. 3 claims.

5,543. "A multiplex selective system of wireless telegraphy." B. Cohen and P. H. Cole. Dated March 14th, 1899. Relates to a system of multiplex selective wireless telegraphy in which, by means of distributors, each apparatus is put into communication with the others in succession for minute intervals of time. The transmitting vertical rod is connected to the spark gap and induction coil, and the receiving vertical rod is connected to the coherer and receiving relay. The form of distributor described consists of a sloping trough down which globules of mercury are allowed to flow intermittently from a reservoir. The trough is provided with contact pins, &c., connected to the receiver and to the keys, &c. Several series of these contacts may be arranged in the trough, and one or more synchronising contacts connected to the magnet operating the release of the mercury globules. In a modified form of distributer, the magnet operates an escapement by which a wiper is freed and is caused to pass over a series of contacts arranged in an arc, thus performing the same functions as the globules of mercury. The apparatus may be employed to receive a number of messages from different lines and by means of a second synchronised apparatus to distribute the messages on to their separate lines. 8 claims.

5,548. "Improvements in devices for changing the frequency of alternating currents and in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated March 14th, 1899. Relates to systems of distribution and to arrangements for changing the frequency of the alternating currents employed. Two or more induction or transformer motors are electrically connected in tandem and geared together, the working circuits of the changed frequency being connected between them. The changed frequency may be produced by causing a slip of the motor by mechanical means or by driving a generator. 25 claims.